ELECTRIC UTILITIES' ACCOUNTING FOR CONSTRUCTION WORK IN PROGRESS: THE EFFECTS OF ALTERNATIVE METHODS ON THE FINANCIAL STATEMENTS, UTILITY RATES AND MARKET TO BOOK RATIO

BY

GERALDINE WESTMORELAND

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ELECTRIC UTILITIES' ACCOUNTING FOR CONSTRUCTION WORK IN PROGRESS: THE EFFECTS OF ALTERNATIVE METHODS ON THE FINANCIAL STATEMENTS, UTILITY RATES AND MARKET TO BOOK RATIO

By

Geraldine Westmoreland

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Electric utilities account for funds used during construction usually by one of three methods or combinations of these methods: 1. They capitalize an allowance for funds used during construction (AFUDC) which is added to the construction work in progress (CWIP) investment and recognize an unrealized AFUDC income for a like amount. This income is realized in cash over the useful life of the asset by way of depreciation and rate base increment. 2. They include CWIP in the rate base and receive a current cash return for construction funds. 3. They include CWIP in the rate base but have an offsetting AFUDC credit to revenue requirements. This study consists of three parts:

1. A computer simulation of two alternative methods of accounting for CWIP. 2. Security market research on the effects on the cost of capital. 3. Current industry practices and regulatory policy surveys.

The two polar methods, AFUDC capitalization and rate base inclusion are simulated under moderate growth assumptions employing a deterministic model. The lead-in period of the simulation provides a realistic vintage of assets with prior capitalized AFUDC. The 25-year simulation compares identical firms which differ only in CWIP treatment. The firm which includes CWIP in the rate base could be compared with one which has switched methods from AFUDC capitalization. The simulation shows the effects of the CWIP accounting treatment on rate base, utility rates, operating and net income, cash flows, internally generated funds and interest coverage. The effects of AFUDC on normalized accounting are also considered.

The hybrid method of including CWIP in the rate base with offsetting AFUDC credits to revenue requirements is modeled for the first time in the literature. The current cash return and the AFUDC return with various assumptions about the allowed rate of return and the AFUDC rate are derived. The compounding of prior AFUDC when this method is employed is fully explored.

The security market research consists of multiple regression analysis and price/earnings trends. The effect of CWIP accounting on the price/book ratio of 100 electric utilities was ascertained employing a linear model. The price/book effect was translated into effect on cost of capital. In addition, an attempt was made to determine if a threshold amount of AFUDC/earnings is necessary before cost of capital is affected. The trend of price/earnings ratios for two groups of electric utilities ranked on AFUDC/earnings is tracked for 1960-1975.

Extensive surveys of the electric utility industry and state public service commissions were run. Accounting practices, methods used to determine the amount of CWIP to include in the rate base, treatments of interest tax benefits and prior AFUDC, and the AFUDC effect on financing are covered. A comparison is made of industry practices with commissions' stated policy.

CHAPTER I

ELECTRIC UTILITIES' ACCOUNTING FOR CONSTRUCTION WORK IN PROGRESS: THE EFFECTS OF ALTERNATIVE METHODS ON THE FINANCIAL STATEMENTS, UTILITY RATES AND MARKET TO BOOK RATIO

Motivation for the Study

Edison Electric Institute, the principal association of the nation's investor-owned electric utility companies, following an intensive research project on the economic growth in the future, came to the conclusion that revisions in public policy will be needed to encourage capital formation and private investment in the productive facilities of electric utilities. The electric utility industry is the most capital intensive industry in the United States. It is heavily dependent on the capital markets and will be competing with industries which are not regulated for capital funds. The financial health of industry is critical to the economy and the nation's energy posture.

Accounting research can aid regulators in their policy decisions. May and Sundem (30) in their discussion on research for accounting policy make several points which are relevant to policy research for regulated industries. Utility commissions, like accounting policy makers, must specify the set of acceptable accounting practices. Their final choice depends on their collective choice rule and social decision system. An important area of research which can aid them in their choice is the development and refinement of accounting alternatives. In developing their model for accounting policy decisions, May and Sundem state:

> A first step in predicting ultimate consequences of policy decisions is to predict their effect on financial statements. Therefore, a prior research, which predicts the financial statement effects of alternative measurement and reporting rules, can be an important research contribution. And where possible, empirical research confirming or describing actual financial statement effects is probably even more helpful. (30, 753)

They also point out that the focus of much of the accounting research concentrates on only the users of financial statement data with little emphasis of the effects on non-users. In decisions concerning accounting methods, the non-users, mainly the ratepayers, are an important consideration. In particular, the effects of the policy on rates is a relevant factor which can be tracked with financial statements and accounting data.

Regarding research strategies, May and Sundem propose:

> A largely neglected (in recent times), but potentially profitable, avenue of accounting research is investigating the degree to which actual accounting time series may be expected to differ under various accounting alternatives, given observable or even assumed or simulated environmental conditions under which firms operate. Although unappealing as a sole basis of choice among accounting alternatives, such investigation can make a potential important, though perhaps prosaic, contribution. . . . (30, 758)

This dissertation asserts that the same approach can be used for research involving the effects of accounting policy on public policy. Its intent is to investigate the effects of the financial statements of an electric utility under two accounting alternatives given a simulated environment and to attempt to describe how the cost of capital has been affected in the past by the accounting method commonly employed.

A further motivation is the nature of the problem which this study addresses. Until the late sixties and early seventies the accounting method used by electric utilities for their construction work-in-progress did not affect their costs in a material manner. Economic conditions were such that the allowed return was realized by most utilities. The size and duration of their construction programs were such as to not create undue financial hardships. As economic conditions changed and allowed returns were not realized and the size and duration of programs increased, the financial integrity of the industry became threatened. Large expenditures were made on nuclear plants which were under construction for eight to ten years. Most firms were not allowed to earn a cash return on these funds due to the accounting method required by regulatory commissions. Consequently, the method employed to realize a return on construction funds affected the cost of the funds.

In 1976, the Edison Electric Institute projected that the investor owned electric utilities will need to make construction expenditures of one hundred twenty-two billion dollars through 1981. Of this amount, 40% will need to be financed with internally generated funds, as compared to approximately 33% which has been the average in recent years. The ability to do this is to a large degree contingent upon the regulatory treatment of the funds tied up in construction programs. The construction programs have increased in size and longevity, as well as in cost. The Federal Power Commission's statistics of privately owned utilities in the United States reports that during the period of 1960-1975 the nominal cost of newly installed generating capacity grew at a compound annual rate of 6.4%. In regard to relative size, in 1960 construction was approxmately 5% of total invested capital for the industry. By 1975 this percentage had risen to around 20%. The results of the 1978 questionnaire survey done in conjunction with this study, utilities project that the percentage will increase to 24% by 1987.

Statement of the Problem

The electric utility industry has a massive construction budget for the remainder of the century. Financing this budget requires that internally generated funds be increased and that externally raised funds be obtained at the lowest possible cost. The accounting method used to recognize a return on funds used during construction affects both the internal generation of funds and the cost of capital.

Since the industry is a regulated monopoly, the interests of the various consumer classes must be balanced with those of the investors. Consequently, the effects of alternative accounting methods on utility rates, as well as on financial statements and the cost of capital, need to be predicted and/or confirmed. The methods used in the past of capitalizing an allowance for funds used during construction (AFUDC) and recognizing a paper income for a concomitant amount has been much discussed in rate cases and trade journals, but in-depth analysis of the effects of the method over time is lacking.

Since the early 1900's public utilities have been allowed to recognize a return on funds which were employed in their construction programs. Two polar methods to recognize this return are (1) include CWIP in the rate base, or (2) capitalize AFUDC.[1] The rate base method includes the construction work in progress in the rate base for purposes of current revenue requirements. This results in current customers paying for the cost of funds used in construction. The capitalization method requires capitalizing the allowance for funds used during construction (AFUDC) by adding to the asset value of the construction work in progress a percent of the construction funds. Income for the period is credited for a like amount. The capitalization method results in an income figure which is composed in part of "operating" cash earnings and in part of "paper" earnings which will commence to be realized in cash when the asset goes "on line" and the greater depreciation expense and a larger rate base return are included in the revenue requirements from the consumer. Proponents of this method claim it results in future customers, who benefit from the construction, paying for the cost of the funds.

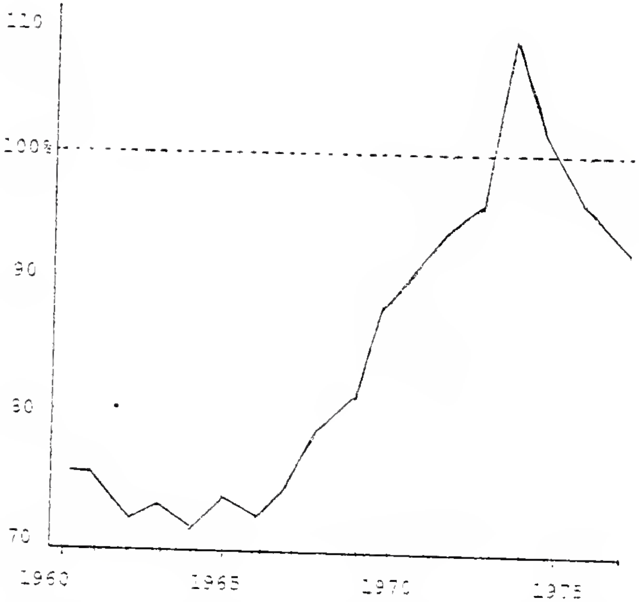
---

[1] A hybrid method is also widely used which includes CWIP in the rate base, and subtracts AFUDC from revenue requirements. This method could result in the return being divided between cash and AFUDC credits. This approach is discussed in depth later.

The present criterion for inclusion of assets in the rate base requires the assets to be "used and useful." To a large extent commissions do not regard construction as meeting this criterion and, consequently, the capitalization method is widely employed. Results of an industry survey done in connection with this research show that approximately 50 percent of the responding firms use the capitalization of AFUDC exclusively.

Simulation studies (39) have shown that if the consumer's time value of money is the same as the firm's, the two methods would result in identical net present values. If this is, in fact, the situation, the method of accounting for funds used during construction is just a bookkeeping method and of little economic consequence to the investor or the consumer. The "paper" earnings are as valuable to the investor as the operating earnings. The determination of the consumer's discount rate is not, however, a feasible approach for policy determination. In addition, there is reason to believe that the investor discounts the quality of the capitalized AFUDC earnings because:

1) the ultimate cash realization depends upon demand during the constructed asset's life and timely rate relief during this time. The uncertainty attached to these two conditions makes it not unlikely that the investor will perceive these earnings as riskier.
2) Cash flow problems are associated with the capitalization method. All other things being equal, a firm which employs the capitalization method must finance externally more frequently than a firm which has all cash operating earnings due to the non-cash nature of AFUDC.
3) In recent years, dividends for many firms employing the capitalization method have been greater than 100% of their cash income. If investors perceive these dividends as riskier, they will demand a higher return. Figure 1 shows dividends as a percentage of net income available for common excluding AFUDC for the privately owned utilities during the period 1960-1977. In 1974 this percentage was 110% and was still over 100% in 1975.



Source: Federal Power Commission "Statistics of Privately Owned Electric Utilities in the United States." (1)

FIGURE 1

DIVIDENDS AS A PERCENTAGE OF NET INCOME AVAILABLE FOR COMMON, EXCLUDING AFUDC, FOR THE ELECTRIC UTILITY INDUSTRY 1960-1977

4) Bond rating agencies disregard AFUDC in excess of a certain percentage of income in calculating bond interest coverage. Consequently, the allowance method can result in a higher cost of debt.

The above mentioned ramifications of the construction accounting method lead to the speculation that the method by which the cost of construction funds is realized is not neutral. It would not be unreasonable to speculate that firms which have a large percentage of AFUDC earnings in their income figure are viewed as more risky than firms which have mostly operating income.

The following excerpt from an article which appeared in the Wall Street Journal on February 23, 1977 (44), points up another problem with the capitalization of AFUDC. Namely, fluctuations in reported income occur frequently when new plants go on-line, and even though operating revenues have increased, reported net income may drop. The operating revenues are not great enough to replace the high AFUDC earnings. In the case below, financing plans had to be postponed.

> NORTHERN INDIANA PS DELAYS STOCK OFFERING
> TO REPORT PROFIT DROP
>
> Despite increased gas and electricity revenues, January net income declined about $1 million from January 1976, Dean H. Mitchell, chairman, said. Per share earnings last month fell to about 28 cents from 36 cents in January 1976. In the 12 months ended January 31, share

> earnings were \$2.43 compared with \$2.50 in the 12 months ended December 3, 1976, he added.
>
> Mr. Mitchell said the lower earnings were caused chiefly by a reduction in the utility's allowance for funds used to finance construction and start-up expense and increased depreciation charges resulting from a new generating unit. The unit, near Wheatfield, Indiana, went into operation in December. The increased operating revenues were not sufficient in Northern Indiana's case to offset the lost AFUDC income and the increased depreciation expense due to the new plant. (44, 37)

The nature and quality of the AFUDC earnings have been the subject of legal action. In a class action suit, Greenapple versus The Detroit Edison Company, Morgan Stanly & Co., Inc., and Price Waterhouse & Co. (24) it was alleged that the prospectus grossly exaggerated actual earnings and the trend of operating earnings for the years 1967 through June 30, 1972, due to their presentation which treated "projected future earnings as if they were actual earnings, under the caption, 'Allowance for funds used during construction.'" The case highlighted the fact that rate making accounting has not resulted in disclosure accounting. Detroit Edison, as had many utilities, built up a construction pyramid which could be deceptive to the novice investor. This pyramid works as follows: When construction on a plant is completed and goes "on line," the AFUDC earnings would, in theory, be replaced with operating cash earnings. However, if rate relief is not granted and demand is not sufficient, earnings will fall. Frequently, as was the case with Detroit Edison, the former AFUDC earnings were not replaced with operating earnings, but with new construction AFUDC earnings, and these earnings were greater than the plant could have generated in operation. When the construction pyramid slows down, the AFUDC earnings evaporate. The actual trend in operating earnings has been "concealed," claim the plaintiffs in this case, by the increased new construction put in progress each year. It was contended that the magnitude of the AFUDC effect created a cumulative income item which distorted the entire presentation of actual earnings power of Detroit Edison.

The litigation described remains unresolved. The complaint seeks damages of $77.5 million against return of the shares sold (less any amounts received by the alleged class or prior sale of their shares), together with interest, attorneys' fees and other costs. The actions taken regarding the case are as follows:

> May 28, 1976, the Court denied defendants' motion for summary judgment without prejudice to renewal upon completion of discovery. On completion of discovery, defendants renewed their motion for summary judgment and plaintiff cross-moved for summary judgment.
> September 23, 1977, the plaintiff moved for a determination of whether the action should be maintained as a class action.
> April 26, 1978, the plaintiff voluntarily agreed to dismiss the action as against the Company's independent accountants and thc underwriter, subject to reinstatement in the event of a trial or other proceeding on the merits. (38, p. 10)

The rate base method has been gaining acceptance as a means of relieving financial stress for the utilities. Following extensive hearings, the Federal Power Commission in late 1976 issued Order Number 555 which recognized that justification does exist for rate base treatment for specific items of CWIP such as pollution abatement and conversion facilities. The reasoning was that the present generation was imposing costs on future generations. This order applies to all companies with FPC jurisdictional assets. In individual proceedings, the Commission will permit other CWIP in the rate base if the company is in severe financial stress. The Federal Energy Regulation Commission (FERC) which has superseded the FPC has continued these orders.

These problems point up the need for an investigation into alternative methods of accounting for CWIP. Even though the policymaker's decision model is not known, it is not unlikely that the effects of the alternative methods on financial statements, cost of capital and utility rates are important inputs.

Concisely, the problem is as follows:

> The allowance method used by electric utilities to account for a return on CWIP has resulted in material problems. Cash flows and capital costs have been affected to an unknown extent. One alternative method, inclusion of CWIP in the rate base, would eliminate these problems, but it has been objected to on the grounds that it is inequitable for current customers to pay for funds which benefit only future customers. There is a need to ascertain the relationships of financial variables involved in the alternative methods and the effects these methods will have on utility rates, capital cost and financial statements.

The hypothesis of this research is that electric utilities' accounting for CWIP has resulted in methods which have embedded in them elements of business, financial, and regulatory risk. Business risk, the uncertainty inherent in projections of future operating income, depends upon (1) the extent to which a firm builds fixed cost into its operations and (2) sales volatility. Relatively small changes in sales result in large changes in profits if operating leverage is high. The electric utilities were regarded for years as having little business risk, but a combination of events in the 1960's and 1970's altered the situation, produced sharp declines in their operating income thereby increasing the industry's business risk (8). This research shows that the accounting treatment of CWIP has contributed to this increased risk. Financial risk, the uncertainty inherent in the firm's ability to cover its fixed financial charges and to provide a reasonable return on equity, depends upon the extent to which a firm uses fixed income securities--debt and preferred stock--to finance its assets. Since AFUDC is not cash income, it is not available for interest and dividend payments. Bond indentures and rating agencies usually exclude a substantial percentage of AFUDC in calculating the times-interest-earned ratio. Therefore, financial risk is affected by CWIP accounting.

Regulatory risk, which is inherent in regulation, increases both the financial and business risk of utilities. It is, in fact, the primary risk of the utility investor.

Regulatory risk is the risk inherent in regulation. The firm's profits and investment decisions are subject to the commission's control. Regulatory risk is present in all regulated firms to varying degrees. Not being directly observable or measurable, the best that can normally be done to measure regulatory risk is to somehow approximate the regulatory climate. This can be done by observing the past history of rate cases considering such factors as level of allowed return on equity, granting of interim rates, rate base test period, time involved in reaching final decisions, treatment of existing stockholders and certain allowed accounting practices. Regulatory risk is characterized by:

(1) Regulatory Lag. This is the time required for the company to ascertain statistics for the test year, prepare and file the documents for increases and commission delibration time.

(2) Attrition. This is the difference between the rate of return on equity granted by the Commission and the actual rate realized. For example, assume the realized rate of return is equal to the allowed rate of return. Assume with time, inflation combined with fixed utility rates cause the actual realized return to decline. If a rate increase is granted, the rate of return rises, but if there is continuing inflation, the target is not attained. Over time the average realized ROE will be less than the cost of equity.

(3) Rate Level. There is a risk inherent in every rate hearing that the allowed rate of return will be less than the cost of capital. Also, there is a risk that assets will be excluded from the rate base, or expenses disallowed for revenue requirements.

(4) Expropriation of locked-in capital. Utilities must frequently go to the securities markets due to their obligation to serve and their dividend policy. If a firm's stock continually sells below book value and the firm is compelled to float security issues at a discount, the locked-in equity holders suffer confiscation of their equity. A confiscation risk also exists to the extent that the commission can alter cost of capital estimation techniques.

(5) Stock Price. The price of a regulated public utility is held to book value in times of inflation, unlike unregulated firms whose prices rise with inflation. This is the result of commissions regulating in a manner which the market to book ratio target is around 1.0.

Other studies (10) have shown that normalization accounting has an effect on the cost of capital to a public utility and thereby demonstrated that regulatory risk could be reflected in an accounting variable. This research shows that an electric utility's CWIP accounting policy is also a risk variable. By showing how the accounting variables and utility rates are interrelated using a deterministic simulation model, it is evident that business and financial risk are increased by use of the CWIP accounting method. When regulatory risk is considered in conjunction with the risk inherent in the methods themselves, it is not surprising that the CWIP accounting variable is an explanatory variable in past market to book ratios.

This research deals with revenue requirements which are necessary to cover the cost of capital funds, not the pricing of electricity, which is a separate issue. The effect on utility rates dealt with in this research is that of revenue requirements per unit of demand under alternative accounting methods. Pricing issues, for example, marginal and/or embedded cost, multipart and/or discrimatory pricing are not the primary focus of this research.

The goals of this research are four fold:

(1) To explicitly state the theory underlying a return on CWIP and their accounting methods.

(2) To describe the effects of the alternative methods on financial variables and utility rates over time. By defining the interrelationships of these financial variables it will be possible, using a deterministic model, to determine whether the methods inherently contribute to the business and financial risk of the utility.

(3) To describe the past effects of AFUDC on the market to book ratio and to infer from this the effect of AFUDC on the cost of capital to electric utilities.

(4) To describe the actual practices of the industry and commissions in dealing with the problem of construction funds.

Methodology

(1) The theoretical justification for allowing a return on construction funds and the methods employed will be explained using regulation, accounting, and finance theory.

(2) A computer simulation model of alternative methods of accounting for CWIP will track the relationships of financial variables and utility rates over time.

(3) Multiple regression models will be used to determine whether AFUDC/NI is an explanatory variable for the market-to-book ratio. Since the market may not discount small percentages, an attempt to find the threshold will be made.

(4) P/E ratios will be examined for firms with high AFUDC/NI ratios versus firms with low AFUDC/NI ratios. Statistical test of significance will be run on the two groups.

(5) Actual practices will be determined employing the literature, FPC orders, and questionnaire surveys run on publically traded utilities and the state public service commissions.

CHAPTER II

PRIOR RESEARCH

Prior research relevant to this study can be classified into three areas; accounting theory of capitalization, research dealing specifically with electric utilities' CWIP accounting, and cost of capital studies of public utilities.

Accounting Literature on Theory of Capitalization

Accounting literature dealing with the theory of capitalization of funds used during construction spans the period of the late 1800's to present day. Early literature dealt primarily with the question of whether the means of acquiring property should have any bearing on its value. More recent works applicable to regulated utilities deal with the income realization aspects. Guthrie (25), in 1886, a proponent of capitalization of "interest" on proprietor's capital during construction, argued that there were two ways of acquiring property, by purchase or construction. If the property were purchased the price would include interest on all capital employed during construction. If property were acquired through construction there would be no objection to capitalizing interest on debt as part of the cost. Why should one type of capital differ from another? Dividends or any interest on proprietor's capital employed should be as much a cost as if the property had been purchased. The means of acquiring property should not, in itself, have any bearing on its true value.

Opponents of capitalization were of the same opinion as Guthrie in regard to value, but reached the opposite conclusion on capitalization. Walton (45), in the July 1916 Journal of Accountancy, reasoned that interest was purely a cost of financiering, and it did not add anything to the intrisic value of the plant. Many values were possible for the same plant depending, not upon the plant, but the financing method. He contended that interest charges should be carried as a deferred charge, along with other expenses of organizing, and amortized over five to ten years.

D.R. Scott (41), in 1925, believed that custom ruled against charging assets for income foregone by stockholders during construction, but saw no objection to allowing the long-term borrowing rate on loans being capitalized, provided the offsetting credit was to a reserve account. He saw the concept of objective evidence as a guideline. If a firm did its own construction, the rate of interest paid should be competitively determined. Since the length of the construction period was not so objectively determined, the total amount might not be capitalized.

Paton (34) in 1920 published an article in the Journal of Political Economy entitled "Interest as a Construction Cost." He opposed the capitalization of interest during construction for industrial enterprises, but was one of the first to point out that it might be perfectly logical to do so in the regulated public utility due to the regulatory process. He objected to unregulated firms capitalizing interest during construction on the basis of the entity theory. If construction funds are secured by a corporation through stock and bond issues, the question of how to account for interest and dividends is to be answered by viewing the enterprise as an operating unit and bondholders and stockholders as capital investors who do not sell their services to the corporation. If the corporation secures funds from these investors, any disbursement during construction would be a reduction of capital since there were no earnings at this time. He contended that accounts should not reflect an accrual for "interest" on investment prior to operation since, from the viewpoint of the accounting unit, there was no real gain in any assets. This interest represented an economic gain but it was not within the accounting framework to record it. In 1952, Paton altered his earlier opinions (35). He shifted his view of the corporate entity towards a "residual equityholders" position. Interest during construction was not a return to a group of capital suppliers, but a service sold by the creditors to the common stockholders. This interest was an incurred cost to the advantage of the stockholder. A reduction in corporate resources had not occurred because of interest paid during construction. Paton was of the opinion that the mode of financing a particular asset during construction should be viewed as a general financing cost, incurred to get the business operating, and charged to a special account rather than to individual asset accounts. This cost would be a permanent asset, similar to organization costs, and not subject to amortization.

Bierman (5), in his 1965 Financial Accounting Theory, argues for capitalization of interest during construction including implicit interest on equity capital. He contends that unless interest is capitalized on both debt and equity during construction, assets and net income of early periods will be understated and in later periods overstated. Bierman suggests that an unrealized income account be credited to stockholder's equity and the credits be recognized in the income statement as the asset is depreciated. This treatment would nullify the argument that profits were created on construction.

The practice of crediting income for an imputed amount when construction interest funds are capitalized is in direct contradiction of the income realization concept as expressed by the American Accounting Association Concepts and Standards Research Study Committee in 1965 (4) and by the APB Statement #4 in 1970 (3). However, the regulated utility is in an unique situation. It must be able to recover all costs of service from the consumer. It could be argued that "rent" on capital funds, both debt and equity, are legitimate costs and there is a reasonable expectation that this cost can be recovered over the life of the asset. However, the accounting literature reveals that the nature and timing of this income for public utilities, like unregulated firms, is also controversial.

Paton (35) views the transaction which increases the cost of the asset through an imputed amount as giving rise to additional investment which should be classified as part of permanent investment, such as paid-in or capital surplus. Walker (43) justifies the recognition as income in the regulated situation on the analogy that the sale is recorded as revenue at the point when collectibility is reasonably assured. Since the time of capitalization is the time commissions allow the imputed cost to be added to the asset value, the collectibility of this imputed amount is reasonably established. Bierman (5), as noted earlier, contends the income should be deferred until the asset is actually producing revenues.

Electric Utilities' Accounting for CWIP

The three most extensive works in this area are Quick's dissertation, "A Computer Simulation Analysis of Alternative Methods of Accounting for Utility Construction Work in Progress" (39), Arthur Andersen's 1977 study for the Federal Energy Administration (14) and Pomerantz and Suelflow's book, Allowances for Funds Used During Construction (37).

The Quick study. Quick (39), did an extensive computer simulation of different accounting treatments for CWIP used by electric utilities. His finding were:

1. The rate-payer's time value of money will affect the preference for construction treatments. If his/her discount rate is lower than the cost of capital to the utility, then the present value of future revenue requirements is lower for rate base firms and greater for capitalizing firms.
2. Firms which capitalize AFUDC have cyclically fluctuating utility rates.
3. Fluctuations caused by the capitalization of AFUDC coincide with the directions of fluctuations caused by the depreciation method.
4. Firms which capitalize AFUDC and employ depreciation methods other than normalizing rely more heavily on external financing.
5. Early periods in the simulation result in different relationships than later stabilized periods.

The research carried out for this dissertation extends the work done by Quick. Assumptions regarding the switching of methods, compounding of prior AFUDC, rate base patterns and deferred taxes on the debt component of AFUDC are changed from Quick's assumptions to be in conformity with current industry practices.

The Arthur Andersen study. The Federal Energy Administration commissioned Arthur Andersen & Co. to do a background analysis of the effects of the inclusion of construction work in progress in the rate base and the normalization of all income tax costs of the electric utility industry. Their analysis included a comparison of the revenue requirements including CWIP in the rate base with AFUDC capitalized as income. Both single property addition and a continuing construction program with various assumptions as to useful life, construction period and costs were employed. The case which was somewhat similar to the research carried out in this dissertation was the simulation of revenue requirements for growing construction programs. They did not employ a lead-in period for the simulation and assumed different rates of return for the two methods. When construction work-in-progress was included in the rate base, the allowed rate of return was 8.9% as compared to 9.6% for the capitalization method. While the cost of capital will be different for firms using the different methods, the comparison of methods is confounded by this difference in rates of return. Conditions are not ceteris paribus.

They addressed the cost of capital question by looking at the common stock prices following a regulatory change in Missouri to exclude CWIP from the rate base. The two major electric utilities were used as an illustration of investor's reaction. The decline in common stock price for both companies relative to the Standard and Poor's Index was observed immediately following the election and the week after. Based on this, they estimated that the overall cost of capital would be higher by approximately .30 to .70 percentage points if CWIP were excluded from the rate base and AFUDC were capitalized.

Pomerantz and Suelflow study. (37) This study addresses the theory underlying the capitalization of AFUDC and the actual procedures for accounting for it. The conclusions regarding the economic and accounting theoretical bases were:

1. There is economic justification for AFUDC capitalization. Since the investor requires compensation commensurate with the value of his current foregone consumption, interest must be measured from the time capital is committed to the construction of productive facilities.
2. Even though AFUDC represents an imputed cost and is a direct contradiction of the income realization principle, the overwhelming importance of including AFUDC in the public utility's total asset cost base justifies its recognition.

Pomerantz and Suelflow describe the actual accounting procedures in detail. They discuss the capitalization rate, give guidelines to follow in seeking to establish a rate and actually develop a procedure which is a weighted moving average cost of capital.

Cost of Capital Studies Relevant to CWIP Accounting

Until recently, accounting and regulation literature have dealt to a large extent with the questions of whether the financing of an asset should affect its value, the nature of the "income" or capitalization credit, and the internal effects of AFUDC. In recent years the question has arisen as to whether the AFUDC capitalization method itself has a cost. The effects on the cost of equity and debt have been raised by Gordon (23) and Pinches et al. (36).

Gordon (23) in his study on The Cost of Capital to a Public Utility did extensive regressions to test theories of capital markets with past market data (1958-1968) on public utilities. Employing the discounted cash flow (DCF) theory of stock valuation, he hypothesized that dividend and earnings yield varies with the risk or uncertainty of the dividend expectation. Among the risk variables that may influence yield he included a quality of earnings index which considered accounting variables which affect cash flows, such as deferred taxes, flow-through accounting and AFUDC. This variable was used in three models which he employed without conclusive results in regard to significance. In all of the models it was significant for some of the years.

The effect of CWIP accounting on financial risk was noted by Pinches et al. (36) in their study of fixed-charge coverage as a determinant of electric utility bond ratings. Multiple discriminant analysis was used to discriminate and predict both Moody's and Standard & Poor's bond ratings. Complete stepwise procedures were employed to select the model. From nineteen variables, the following six were chosen: regulatory climate, total assets, net income/total assets, earnings before interest and taxes/fixed charges, construction expenses/total assets, and 1970-1975 growth rate in net earnings. AFUDC/net income was one of the considered variables but was highly correlated with the selected variables and not included in the discriminate model. The effect on bond rating of the six variables was as follows: The more favorable the regulatory climate, the higher the bond rating. Except for Baa (BBB) group, the larger the firm in total assets, the higher the rating. The large average size for the Baa (BBB) group was caused by the presence of several large firms including Con Ed of New York and Detroit Edison. The higher rated firms tend to be more profitable in terms of net income/total assets and have higher fixed coverage levels (EBIT/fixed charges), than lower rated firms. The higher rated firms tend to have a higher rate of construction expenses to total assets. This may be due to the fact that firms in the Aa(AA) group tend to cluster in the Midwest and Southern regions of the country--areas where the demand for electrical energy is growing faster than the national average. Lower growth rates in net earnings were experienced by the higher rated firms. This seeming inconsistency was attributed to the accounting treatment for two items. First, the heavier capital expenditures experienced by higher-rated firms indicate that relatively more generating capacity was being placed into service by these firms. This would cause depreciation expenses to be greater for higher-rated firms, resulting in lower reported earnings and lower growth rates. Second, an examination of the variable AFUDC/net income indicated that AFUDC represented a larger percentage of net earnings for lower-rated firms than for the higher-rated firms. Pinches notes:

> . . . in such situations, while total reported earnings may be growing faster for lower-rated firms, financial analysts rating electric utility bonds recognized that the "quality" of earnings growth was poorer since it was due to the inclusion of large amounts of AFUDC (3, 47).

This discriminant model correctly predicts 70% of Moody's ratings, 76% of Standard & Poor's, and 81% of the ratings for those firms when both agencies assigned the same rating.

In an attempt to obtain some insight into the relative importance of the six variables a rank ordering according to five criteria was done. The univariate F ratio, the scaled weighted method, the forward stepwise and backward stepwise methods, and the conditional deletion method were the five criteria. The univariate F and stepwise forward methods showed that fixed coverage was the most important variable by itself for both Moody's and Standard & Poor's bond ratings. However, in a multivariate framework when all variables in the model are considered simultaneously (as seen by the scaled weighted, conditional deletion, and stepwise backward criteria), fixed coverage becomes one of the least important variables and growth in net earnings one of the most important variables. The reason fixed coverage is less important in a multivariate context is because of the intercorrelation between it and the other five variables. Pinches claims the findings indicate that attempts in electric utility regulatory proceedings to specify exact fixed coverage ratios that must be achieved in order to maintain (or secure) a given bond rating are both short-sighted and incomplete.

Johnson (26) compared price/earnings and price/book value ratios of two groups of companies which employed different CWIP accounting methods and reported a significant difference between the groups with the capitalizing group having the lower ratios. Group one consisted of 45 companies which capitalized AFUDC and realized no cash return on their CWIP. Group two consisted of firms which included CWIP in the rate base with an offsetting credit to revenue requirements for AFUDC. This method results in the possible realization of some cash return on CWIP if there is a difference in the AFUDC rate and the allowed rate on the rate base and if the prior AFUDC accumulated on CWIP is also allowed in the rate base. Johnson did not note in his work how or if he could ascertain these two conditions.

CHAPTER III

REGULATORY THEORY OF ELECTRIC UTILITIES' CWIP ACCOUNTING PRACTICES

Introduction

In 1920, Paton (34) noted that the accounting for construction work in progress for regulated industries is subject to a different logic than for unregulated firms due to the nature of the rate making process. The literature is scant on the theoretical development of construction accounting methods from regulatory theory. The objective of regulation is to simulate competitive outcomes to achieve welfare maximization. The actual practice which has evolved for utility pricing is accounting oriented, based on embedded costs rather than marginal cost. As noted in Chapter I, this research does not deal with the pricing controversy, but is concerned with revenue requirements which must be recovered from the consumer regardless of the pricing scheme. The Supreme Court established the philosophy of recovering all historical costs from the consumer including a "just and reasonable" rate for the cost of capital funds as a legal principle underlying regulation with the Hope case. In arriving at a "just and reasonable" rate for the capital charges employing this embedded cost approach to pricing, a situation unique to regulated industries is evoked according to finance theory. The book value of the stock will be equal to the market value if a firm consistently earns a book rate of return equal to the cost of capital. Thus, commissions have been supplied with a rule of thumb for checking the accuracy of their estimate of the cost of capital, namely the market to book ratio.

In this chapter, regulatory theory and the microeconomic theory of marginal pricing are briefly addressed. The embedded cost approach and the legal precedents for the rate making formula are given. The sensitivity of utility rates to changes in the rate base are derived under the two polar methods of accounting for CWIP. A third method commonly used in practice, which includes CWIP in the rate base and subtracts AFUDC from revenue requirements, is modeled with the effects of compounding and rate differentials derived.

Regulatory Theory

The organization and management of public utilities is, for the most part, private with the central economic decisions subject to direct government regulation. The four components which distinguish the public utility from the other sectors of the economy are (28):

1. control of entry,

2. price fixing,
3. prescription of quality and conditions of service,
4. the imposition of an obligation to serve all applicants under reasonable conditions.

From 1877-1934 the U.S. Supreme Court took the position that there were certain more or less readily identifiable industries "clothed" or "affected" with a public interest "to justify" legislatures subjecting them to regulation. In 1934, in Nebbia v. New York, (32) the Supreme Court abandoned the historic distinctions. It held that there was no longer any constitutional barrier to legislatures imposing any types of economic regulation on any industries within their jurisdictions, where in their judgment, it would serve the public interest. Formerly, the Fourteenth Amendment was used as protection from regulation by industries other than the specifically identified "public interest" industries. As a consequence of this case, however, as far as the U.S. Constitution is concerned, there is no longer any distinction between public utilities and other industries.

Yet, there is such a thing as a public utility. There remains a core of industries, privately owned and operated in this country which, in principle, the primary guarantor of acceptable performance is the regulatory commission which controls entry, price, and conditions of service. Kahn (28, 11) contends that economic justification for inclusion in this category would involve the following:

1. These industries constitute a large part of the infrastructure of economic development. They are suppliers of essential inputs to other industries and influence the size and growth of the entire economy. Many are characterized by great economies of scale.
2. Many are classified as "natural monopolies." Their costs will be lower if they consist of a single supplier.
3. For many possible reasons, competition does not work well.

Microeconomic Prescriptions

Microeconomic theory can provide regulators with principles which are assumed to maximize consumer satisfactions if followed. They are behavioral rules describing how prices should be set and descriptions of the ideal results that these rules are supposed to produce. However, as Kahn notes:

> . . . its principles alone do not provide a sufficient set of policy rules for regulated industries. They do not answer the question of how and by what institutional arrangements those ideal results are to be achieved (28, 18).

The essence of regulation is the replacement of competition with governmental orders on price, quality and conditions of service along with an obligation to serve. The single most widely accepted rule for the governance of the regulated industries is to regulate them in such a way as to produce the same results as would be produced by effective competition if it were feasible. If the market is perfectly competitive, the central policy prescription of microeconomics is to set price equal to short-run marginal cost. Economic efficiency requires that price equal to marginal instead of average total costs, as long as demand has some elasticity so that the marginal benefit to the consumer of the additional output (as evidenced in the price they pay) is equal to the incremental costs of producing that output. The consumer will buy more (less) than the optimum amount if price is lower (higher) than marginal cost. In theory, it is short-run marginal cost to which price should be equated because it is short-run marginal cost that reflects the social opportunity cost of providing the additional unit that buyers are at any given time trying to decide whether to buy.

Another important criterion of marginal cost is that it should reflect causal responsibility. The cost should include all and only costs imposed on the economy by the provision of one additional unit. To the extent that maintenance, depreciation, cost of capital, and various other overhead expenses are not a function of use, they do not belong in the ideal short-run marginal cost. Depreciation is to a large extent a provision of obsolescence, not physical deterioration as a result of production. Regarding capital cost, the minimum necessary return on capital is a function of time instead of utilization. Therefore, economically efficient pricing would include only the depreciation which varies with use, based on incremental future cost, and no capital return.

Short-run marginal cost pricing does not necessarily mean that long-run or fixed costs will not be covered. Depending upon the cost behavior of the industry and the relation of market demand to plant or industry capacity, fixed costs will be covered without ever explicitly being included in price (22). If average total cost curve turns up at any point of output, it will be caused by marginal costs exceeding total unit cost. Beyond this point, marginal cost pricing will more than cover average total cost for constant or increasing cost industries.

Legal Precedents and Embedded Cost Approach

The actual procedures which have evolved in practice are quite different from the economist's prescription (29). The process of rate-making involves the determination of revenue requirements for a test year which will cover operating expenses, which include income taxes and depreciation, plus a "just and reasonable" rate of return on a "capital rate base."

The legal principles underlying the regulation of public utilities rest primarily on two Supreme Court cases: *Bluefield Water Works & Investment Co. v. Public Service Commission of the State of West Virginia* (262 U.S. 679, 1923) (6), and *Federal Power Commission v. Hope Natural Gas Company* (320 U.S. 391, 1944) (17).

The Bluefield case stated the standard against which just and reasonable rates is measured

> A public utility is entitled to such rates as will permit it to earn a return on the value of the property which it employs for the convenience of the public equal to that generally being made at the same time and in the same general part of the country on investments in other business undertakings which are attended by corresponding risks and uncertainties. . . . The return should be reasonably sufficient to assure confidence in the financial soundness of the utility, and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise money necessary for the proper discharge of its public duties. (Bluefield, 693)

The Hope case gives legal sanction to the covering of all costs, including capital costs

> From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on the debt and dividends on the stock. . . . By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. (Hope, 603)

Consequently, the rate-making process involves the determination of a "just and reasonable" rate of return applied against a "capital base." The determination of both of these factors have been the subject of considerable controversy.

The "just and reasonable" rate of return to the equity holder has been arrived at by two main approaches in regulatory proceedings in the past: "comparable earnings" and "discounted cash flow." The "comparable earnings" approach involves analyzing rates of return on the book value of the equity capital of various industry groups, both regulated and unregulated, and establishing a comparable "investment risk." Significant problems were encountered in this approach. Namely, the procedure leads to circularity for comparison of rates of earnings with other regulated companies and comparisons of rates of earnings on regulated and unregulated companies are not valid due to the difference in investment risk and accounting practices.

Since the mid 1960's, the "discounted cash flow" approach has been used as an alternative to the "comparable earnings." The theory was first developed by John Buer Williams (46) and later extended by Gordon. It contends that investors discount the expected future cash flows attributed to a security to arrive at its value. The cash flows include dividends and eventual liquidation value. The discount rate is a market determined rate that takes into account current market conditions and investment risks. This approach has resulted in the one rule of thumb recommended by many experts based on finance theory. If a company's allowed rate of return on book value is set exactly equal to the investors' required rate of return then the company's market value per share will approximate its book value. Therefore, the price/book ratio of a utility should be equal to 1.

Robichek (40) contends that maintaining market value around book value is tantamount to converting an equity security into a perpetual, subordinated bond and that the capital asset pricing model would be a better approach to measuring required return. The Public Utility Commission in Oregon recently ruled that the capital asset pricing model be the primary means of determining the required rate of return on equity. The lack of accuracy in determining beta, the subjectivity of the risk-free rate, the choice of a market index, and the underlying assumptions of the model, make this method controversial [Meyers (31) Breen and Lerner (7)]. Oregon is an exception, not the rule, in using this approach, even though it is being used increasingly as substantiating evidence with the discounted cash flow method in rate cases. Robichek noted that the problem of providing a "just and reasonable" return on "plant under construction" would still plague regulators with the capital asset pricing model approach.

The determination of the "capital base" with the embedded cost approach which is used in practice raises questions as to what should be included or excluded from the base, the test period to use, and the valuation basis. In regard to what should be included or excluded, the traditional criterion has been to include all assets which are "used and useful." Yet, this description lends itself to many interpretations. Constuction work in progress could be classified as "used and useful" if it could be shown that the capitalization of AFUDC increases the cost of capital. It could also be argued that CWIP is necessary for the "going concern" concept and is vital for continuing service for present customers. The test year approach attempts to incorporate the future into the regulatory scheme. The strict historical test year assumes the past relationships among revenues, costs, and net investment during the test year will continue into the future. To implement it, a recent 12-month period is selected as the test year and rates are designed so the "fair rate of return" will be achieved. Due to accelerated inflation since the late 1960's, utilities have increasingly been allowed to use future test years. The valuation basis of the rate base was extremely controversial prior to the 1944 Hope decision. Reproduction cost or "fair value" had been employed in the past and endless contention existed over the proper valuation of sunk capital. In the Hope decision, the Court asserted that it would no longer insist on Commissions taking reproduction cost into account in fixing rates. The result, not the method employed, was to be controlling. As long as regulation treats the investors sufficiently well, the Court will pose no particular base. Attention was then shifted from a preoccupation with the rate base to the question of "fair" rate of return. The controversy over the rate base still exists, however. With price levels increasing since the Hope decision, some companies have been allowed to use "fair value" or reproduction cost. (Of the 100 companies in

Solomon Brothers Electric Utility Common Stock Market Data, thirteen use fair value rate bases.)

The calculation of revenue requirements which has evolved in practice, and comprises the embedded cost approach, can be illustrated by referring to a utility's balance sheet and income statement. Figure 3 shows a firm with \$500 total assets which have been financed equally by debt and equity. Assuming that the "allowed" return is the "realized" return, the method of calculating rates can be seen by looking at the rate formula. This firm does not include CWIP in its rate base. The rate base includes only the net plant-in-service. The average revenue (P) can be expressed as Equation 1:

$$\begin{array}{l}\text{average}\\\text{revenue}\end{array}\ (P) = \frac{\text{revenue requirements (R)}}{\text{quantity demanded (Q)}} = \frac{OE' + k_a RB}{Q}\ .$$

(Equation 1)

where:

k_a = allowed rate of return on rate base. It is calculated as a weighted average of debt and equity

RB = rate base assets which, in this calculation, include only net plant-in-service

OE' = operating expenses which include depreciation and income taxes.

Since depreciation and income taxes are related to the problem addressed by this dissertation, they will often be dealt with separately in the discussion of rate making.

Balance Sheet (Beginning of Period)

Assets		Liabilities and Equity	
Plant in service (net of depreciation)	\$400	Debt (D) at 8% (k_d)	\$250
CWIP	100	Equity (E) estimated fair return of 12% (k_e)	250
Total assets	\$500	Total liabilities and equity	\$500

Income Statement (End of Period)		Rate-making Formula
Revenues	\$134	Revenue requirements (R)
		= Demand (Q) X Rate (P)
Operating expenses		= OE' + k_aRB
Fuel	30	(\$94) + (\$40) = \$134
Other operating expenses	8	
Maintenance	12	
Depreciation	10	
Income taxes	24	= Operating expenses (OE')
Other taxes	10	
Total expenses	\$94	
Operating income	40	Rate of return (k_a) on rate base (RB)
Other income		
Allowance for funds used during construction	10	Rate of return (k_{AFUDC}) on CWIP
Income before interest	50	Rate of Return on total assets: ($k_a RB + k_{AFUDC} CWIP$)
Interest	20	$-k_d D$
Net income	\$30	$k_e E$

$$\boxed{k_a RB + k_{AFUDC} CWIP = k_a D + k_e E}$$

(Equation 3)

FIGURE 2

RATE MAKING FORMULA DERIVED FROM UTILITY'S FINANCIAL STATEMENTS

To more readily see their effects, the general formula will be expressed as:

Revenue requirements (R) = operating expenses (OE) which are exclusive of depreciation and income tax + depreciation (D) + federal income taxes (T) + allowed rate of return (k_a) X rate base (RB).

Equation 1 can be expressed as:

$$P = \frac{R}{Q} = \frac{k_a(RB) + D + T + OE}{Q} \quad \text{(Equation 2)}$$

Referring to Figure 2, it can be seen that net cash revenues have been \$40 and \$10 of AFUDC credits have been earned this period. Equation 3 on Figure 2 gives the balancing equation.

The \$10 AFUDC will be added to the CWIP value. When the asset goes on-line and the CWIP account is closed to plant-in-service, a cash return will begin to be realized through depreciation expense and rate base return on this increment.

The point of contention which has arisen over construction work in progress is whether the CWIP should be allowed in the rate base. If this is permitted, the revenue requirements must net \$10 for the return on CWIP. The current rates would be adjusted upward accordingly. There would be an income tax effect since taxes would have to be paid on this return. If a 50% tax rate is assumed, revenue requirements would need to increase \$20 for a net \$10 after-tax return.

Effect of Rate Base on Utility Rates

It is apparent that the CWIP return will affect future depreciation expense, income taxes, and capital return by way of the rate base. The sensitivity of rates to a change in rate base can be determined by the total differentiation of rates with respect to the rate base.

Expressed in functional form

$$\begin{aligned} \text{rates } (P) &= f[\text{rate base } (RB),\ \text{operating costs } (OE) \\ &\qquad \text{depreciation } (D),\ \text{taxes } (T),\ \text{and demand } (Q)] \\ P &= f[(RB),\ (OE),\ (D),\ (T),\ (Q)] \end{aligned}$$

The total differential, which gives the change in utility rates with respect to a change in the rate base can be expressed as

$$\begin{aligned} \frac{dP}{d(RB)} = {} & \overset{(1)}{\frac{\partial f}{\partial (RB)}\,\frac{d(RB)}{d(RB)}} + \overset{(2)}{\frac{\partial f}{\partial (OE)}\,\frac{d(OE)}{d(RB)}} + \overset{(3)}{\frac{\partial f}{\partial (D)}\,\frac{dD}{d(RB)}} + \\ & \overset{(4)}{\frac{\partial f}{\partial T}\,\frac{dT}{d(RB)}} + \overset{(5)}{\frac{\partial f}{\partial Q}\,\frac{dQ}{D(RB)}} \qquad \text{(Equation 4)} \end{aligned}$$

Terms (2) and (5) are assumed to be zero.

$$\frac{\partial f}{\partial (OE)}\ \frac{d(OE)}{d(RB)} = 0, \quad \frac{\partial f}{\partial Q}\ \frac{dQ}{d(RB)} = 0$$

It is assumed that variable operating expenses (OE) and demand (Q) are not affected by CWIP accounting changes in the rate base. While demand does have some price elasticity as witnessed by the decrease in consumption following the oil embargo, it is considered to be slight. Consequently, for simplicity and lack of a good estimate, demand is considered to be price inelastic. Employing these assumptions, the difference in rates caused by a small change in rate base can be expressed as:

$$\frac{dP}{d(RB)} = \frac{\partial f}{\partial (RB)} + \frac{\partial f}{\partial (D)} \frac{dD}{d(RB)} + \frac{\partial f}{\partial T} \frac{dT}{d(RB)} \qquad \text{(Equation 5)}$$

The first term on the right hand side $\frac{\partial f}{\partial (RB)}$ measures the direct effect of a rate base change on utility rates, while the second two terms measure the indirect effects of depreciation and taxes. By taking the partials of the rate-making formula, the coefficients for Equation 4 can be found.

$$P = \frac{ka\ (RB) + D + T + OE}{Q}$$

$$\frac{\partial P}{\partial RB} = \frac{ka}{Q}, \cdot \frac{\partial P}{\partial D} = \frac{1}{Q}, \text{ and } \frac{\partial P}{\partial T} = \frac{1}{Q}.$$

The sensitivity of utility rates to changes in the rate base, assuming price inelasticity, can be expressed as

$$\frac{dP}{d(RB)} = \frac{ka}{Q} + \frac{1}{Q} \frac{dD}{d(RB)} + \frac{1}{Q} \frac{dT}{d(RB)} \qquad \text{(Equation 6)}$$

The direct effect is then seen to be $\frac{ka}{Q}$. A dollar change in the rate base would be modified by the quotient of the allowed rate of return on the rate base divided by the anticipated demand. The indirect effects would be the differences in depreciation and taxes caused by a change in the rate base, both modified by the reciprocal of demand.

Effect on Utility Rates Caused by Rate Base Method

If CWIP is included in the rate base, the direct effect of d(RB), is positive during the construction period, due to CWIP additions and the indirect effect on taxes $\frac{1}{Q}\frac{dT}{d(RB)}$ will be positive due to larger capital costs. The difference in depreciaton, dD, will be zero. Therefore, the difference in rates due to a change in the rate base for any year in the construction period (c) can be expressed as:

$$\frac{dP_t}{d(RB_t)} = \frac{ka_t}{Q_t} + \frac{1}{Q_t}\frac{dT_t}{d(RB_t)}.$$

Over the life of the construction program the difference in rates can be expressed as the intergral.

$$\int_o^t \frac{dP_t}{d(RB_t)}\,dt = \int_o^t \frac{ka_t}{Q_t}\,dt + \int_o^t \frac{1}{Q_t}\frac{dT_t}{d(RB_t)}\,dt.$$

When the construction is completed, the sign of the direct effect will change from positive to negative, since CWIP additions to the rate base will cease, and depreciation will begin on the asset. The difference in rates for any year in the operating life can then be expressed as

$$\frac{dP_t}{d(RB_t)} = \frac{ka_t}{Q_t} + \frac{1}{Q_t}\frac{dD_t}{D(RB_t)} + \frac{1}{Q_t}\frac{dT_t}{d(RB_t)}.$$

Over the life (n years) of the asset, the difference is

$$\int_n \frac{dP_t}{d(RB_t)}\,dt = \int_n \frac{ka_t}{Q_t}\,dt + \int_n \frac{1}{Q_t}\frac{dD_t}{d(RB_t)}\,dt +$$

$$\int_n \frac{1}{Q_t}\frac{dT_t}{d(RB_t)}\,dt.$$

Effect on Utility Rates Caused by Capitalization of AFUDC with no CWIP in the Rate Base

If CWIP is excluded from the rate base during the construction period, there will be no effect on utility rates due to a rate base change. However, when the construction is completed, (t*) the rates will be affected as shown in equation 5,

$$\frac{dP_{t*}}{d(RB)_{t*}} = \frac{ka_{t*}}{Q_{t*}} + \frac{1}{Q_{t*}}\,\frac{dD_{t*}}{d(RB)_{t*}} + \frac{1}{Q_{t*}}\,\frac{dT_{t*}}{d(RB)_{t*}}$$

with all three terms being positive. Since the resulting capitalized cost is greater under this method than with the rate base method, due to the capitalized AFUDC, the d(RB), dD and dT will all be larger with a greater fluctuation in utility rates than the rate base method. In order to make the tracking of these effects over time feasible, a computer simulation model is developed for the alternative methods.

Model of Hybrid Method: Inclusion of CWIP in Rate Base with Offsetting AFUDC Credits

The capitalization of AFUDC on all funds used during construction or the inclusion of all funds in the rate base are the two polar methods. A combination of these methods is frequently used in practice. In addition, a third method is employed by many firms which can result in a current cash return on CWIP even though AFUDC is capitalized. This method includes CWIP in the rate base, yet deducts AFUDC from current revenue requirements. This method can be explained employing the simple model developed earlier for Figure 3. The accounting return which the firm will receive on total assets each period when the rate base (RB) excludes CWIP is: $ROA = k_a(RB) + k_{AFUDC}(CWIP)$ (Equation 3). The return on the rate base is $k_a(RB)$ and the return on CWIP is $k_{AFUDC}(CWIP)$. Current revenue requirements (R) are operating expenses (OE') and capital return, which is the return on the rate base ($k_a(RB)$). If CWIP is allowed in the rate base and AFUDC is subtracted from revenue requirements, the new modified rate base is RB + CWIP, and the AFUDC subtraction is $k_{AFUDC}(CWIP)$. The capital revenue requirements (R') can then be expressed as:

$R' = k_a(RB + CWIP) - k_{AFUDC}(CWIP)$ (Equation 7)

Return on assets each period is the capital requirement (R') and the capitalized AFUDC, or:

$$ROA = \underbrace{k_a(RB + CWIP) - k_{AFUDC}CWIP}_{\text{current cash return}} + \underbrace{k_{AFUDC}CWIP}_{\text{AFUDC return}} \quad \text{(Equation 8)}$$

which simplifies to:

$ROA = k_a(RB + CWIP)$ (Equation 9)

This method results in a total accounting return on assets equal to the allowed return on the rate base. The form of this return, current cash revenues or AFUDC credits, is a function of the allowed return on the rate base, ka, and the AFUDC rate, k_{AFUDC}, as well as the CWIP base. Table 1 shows the form of the return on CWIP when the rate

TABLE 1

RETURN ON CWIP WHEN CWIP IS INCLUDED IN THE RATE BASE WITH AFUDC CREDIT TO REVENUE REQUIREMENTS

Equation for Return on Assets:

$$ROA = \underbrace{k_a(RB + CWIP) - k_{AFUDC}CWIP'}_{\text{Cash return}} + \underbrace{k_{AFUDC}CWIP'}_{\text{AFUDC Credits}}$$

Assumptions:
1. 2 asset firm: RB, CWIP
2. CWIP = CWIP', firm consistently treats compounding of prior AFUDC.
3. Allowed return k_a is realized return.

k	Cash Return	AFUDC Return	Total Accounting Return on CWIP
a = AFUDC	0	$k_{AFUDC}CWIP$	k_aCWIP
a > AFUDC	$CWIP(k_a - k_{AFUDC})$	$k_{AFUDC}CWIP$	k_aCWIP
a < AFUDC	$\langle CWIP(k_{AFUDC} - k_a)\rangle$	$k_{AFUDC}CWIP$	k_aCWIP

differs, assuming the CWIP base is the same for the rate base as for revenue requirement reduction.

If the CWIP amount in the rate base includes prior period's AFUDC, the firm is compounding AFUDC regardless of whether the AFUDC subtraction from current revenue requirements, $k_{AFUDC}CWIP$, contains prior AFUDC or not Consider Equation 10:

$$ROA = \underset{\text{current cash return}}{k_a(RB + CWIP) - k_{AFUDC}CWIP'} + \underset{\text{AFUDC return}}{k_{AFUDC}CWIP'}$$

Note that this equation is different from Equation 8 in that the CWIP base for current revenue requirement reduction is CWIP' and the rate base CWIP is lacking the apostrophe. These bases may be different. The term (RB + CWIP) is the rate base and it was shown in Equation 9 that the return on total assets was $k_a(RB + CWIP)$. If the CWIP amount in the rate base contains prior period's AFUDC equal to P, then the overall compound element received will be equal to k_aP. If the subtraction from revenue requirements $k_{AFUDC}CWIP'$ does not contain P in the CWIP base, then the compound element k_aP will be received as a cash return in this period's current revenue. The cash return due to compounding of prior AFUDC is also a function of difference between the allowed return on the rate base (ka) and the AFUDC rate (k_{AFUDC}). The possible forms of return on prior period's AFUDC are shown in Table 2.

It can be seen that if prior AFUDC is consistently included in the rate base and the revenue requirement, the

TABLE 2

RETURN ON PRIOR AFUDC (P) WHEN CWIP IS INCLUDED IN THE RATE BASE WITH AFUDC CREDITS TO REVENUE REQUIREMENTS

Equation for Return on Assets:

$$ROA = \underbrace{k_a \underbrace{(RB + CWIP)}_{\text{Rate Base}} - k_{AFUDC}CWIP'}_{\text{cash return}} + \underbrace{k_{AFUDC}CWIP'}_{\text{AFUDC Credits}}$$

Assumptions:
1. 2 asset firm: RB, CWIP
2. allowed return - realized return
3. P = prior AFUDC

CWIP	CWIP'	k	Total Accounting Return on P	Return on prior AFUDC (compound increment) Cash Return	AFUDC Credit
+P	+P	a=AFUDC	$k_a P$	0	$k_{AFUDC}P$
+P	+P	a>AFUDC	$k_a P$	$P(k_a - k_{AFUDC})$	$k_{AFUDC}P$
+P	+P	a<AFUDC	$k_a P$	$<P(k_{AFUDC}-k_a)>$	$k_{AFUDC}P$
+P	-P	a=AFUDC	$k_a P$	$k_a P$	0
+P	-P	a>AFUDC	$k_a P$	$k_a P$	0
+P	-P	a<AFUDC	$k_a P$	$k_a P$	0
-P	+P	a=AFUDC	0	$<k_{AFUDC}P>$	$k_{AFUDC}P$
-P	+P	a>AFUDC	0	$<k_{AFUDC}P>$	$k_{AFUDC}P$
-P	+P	a<AFUDC	0	$<k_{AFUDC}P>$	$k_{AFUDC}P$

form of the return depends upon the rates k_a and k_{AFUDC}. However, if the prior AFUDC is inconsistently included in either of the CWIP amounts, the returns will vary. If P is ever included in the rate base CWIP, the total accounting return will always be k_aP with the amount and form varying according to k_{AFUDC} and CWIP', the revenue requirement amount. If P is excluded from the rate base CWIP, prior AFUDC is never effectively compounded.

Effect of AFUDC on Interest Coverage Ratio

One indicator of financial risk used by bond rating agencies is a firm's interest coverage ratio. While the exact weight attached to this ratio is not known, it cannot be denied that the ability to service debt will affect its cost. Since AFUDC is not a cash earning, it is not available to pay interest charges regardless of a frequent practice of including a small percentage for coverage purposes.

Using the embedded cost approach to utility pricing and assuming a typical capital structure, the sensitivity of coverage ratio to rates of return and AFUDC percentage can be derived. This sensitivity is evidence that the CWIP accounting method can affect the financial risk of a utility.

Assuming the following:

TIE = time interest earned

EBIT = earnings before interest and taxes

k_d = cost of debt

D = % debt in capital structure

k_e = rate of return on common equity

E = % earnings equity in capital structure

t = tax rate

A = AFUDC

the effect of AFUDC on the time interest earned ratio can be derived as:

$$\text{EBIT} = k_dD + k_eE + \text{taxes}$$

$$\text{taxes} = (\text{EBIT} - A)t - k_dD\ t$$

Let EBIT - A = EBIT*

$$\text{TIE} = \frac{\text{EBIT*}}{k_dD}$$

$$\text{TIE} = \frac{k_dD + k_eE + (\text{EBIT} - A)t - k_dD\ t - A}{k_dD}$$

$$\frac{\text{EBIT*}}{k_dD} = 1 + \frac{k_eE}{k_dD} + \frac{(\text{EBIT})t - k_dD\ t - A - At}{k_dD}$$

$$\text{TIE} = 1 + \frac{k_eE}{k_dD} + \frac{(\text{EBIT})t - k_dD\ t}{k_dD} - \frac{A(1 + t)}{k_dD} \qquad \text{(Equation 11)}$$

The effect of AFUDC on the coverage ratio is therefore $-\frac{A(t + 1)}{k_dD}$. The tax term reflects the fact that taxes are not included for AFUDC in revenue requirements and therefore cannot be added back for coverage purposes.

The sensitivity of TIE to rates of return on equity and AFUDC can be shown by assuming a capital structure and embedded cost for debt and preferred stock. Figure 4 shows a firm with 55% debt and 45% equity which is composed of 30% preferred and 70% common. Given the embedded cost for debt and preferred, and assuming different rates of return on common equity from 7% to 16%, the TIE ratio was calculated for different percentages of AFUDC. As can be seen, if a 14% return on common is allowed and anticipated, close to 42% of EBIT can be AFUDC before coverage falls below 2 times. However, if the allowed 14% rate is not realized, but instead a 9% rate is realized, coverage falls to around 1.7 times if AFUDC stays the same percentage of earnings. However, with this situation, AFUDC as a percentage of earnings would rise, making the coverage even less.

Market to Book Ratio as a Cost of Capital Indicator

Employing a situation unique to regulated utilities, namely that profits are based on book values, and using the discounted cash flow theory for stock price valuation, it can be shown that the price of a utility's stock should be equal to its book value if they have been allowed to earn, and in fact, do earn their cost of equity capital.

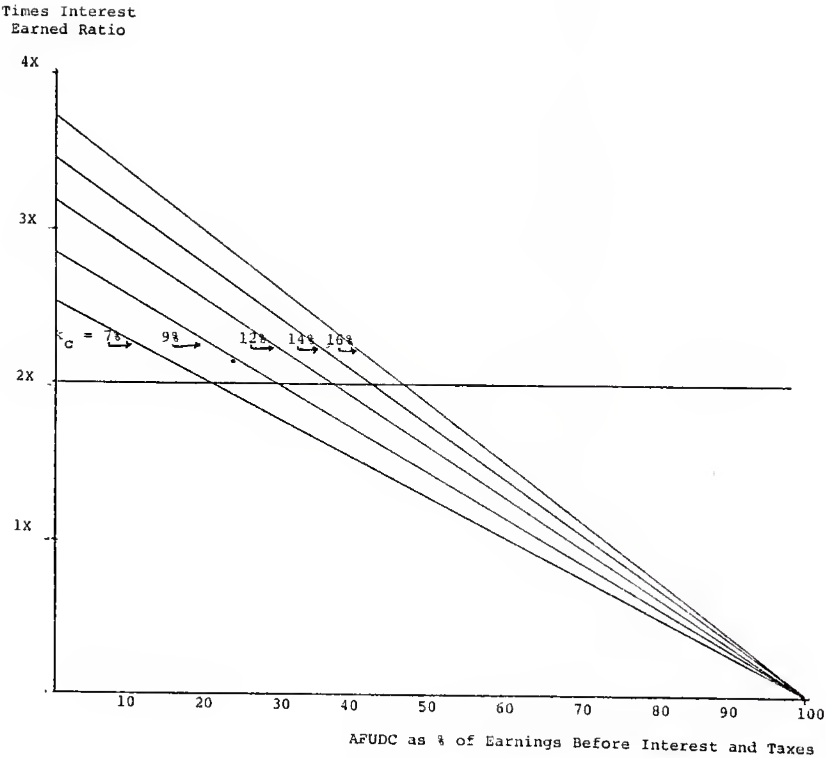


FIGURE 3

THE EFFECT OF AFUDC ON TIMES-INTEREST-EARNED RATIO: THE RETURN ON EQUITY CAPITAL EARNED AND THE RESULTANT TIMES INTEREST EARNED RATIO WITH VARYING PERCENTAGES OF AFUDC EXCLUDED FOR RATIO CALCULATIONS

The relationship of the market price to book value is:

$$P = \frac{D_1}{k - g} = \frac{(1-b)rB}{k - br} \qquad \text{(Equation 12)}$$

where P = price per share

D_1 = next period's dividends

k = required rate of return for equity

r = rate of return allowed by Commission

b = earnings retention rate

B = book value per share

if $k = r$, then $P = B$.

The relationship of market to book ratio when the allowed return is not equal to the cost of equity can be expressed as:

$$P/B = \frac{(1 - b)r}{k - br}$$

While this relationship is not linear, Brigham and Bankston (9) have shown that for values of r within a reasonable range around the appropriate value of k, that P/B is linearly related to the allowed rate of return, r. Gordon (23) has found risk factors in addition to return on equity can be used to explain past P/B ratios. Consequently, a hypothesis of this research is that the CWIP accounting variable (expressed as AFUDC as a percentage of earnings) has embedded in it elements of regulatory risk which have affected the cost of capital and thereby the P/B ratio.

CHAPTER IV

COMPUTER SIMULATION

Overview of the Model

The essence of the model is the period-by-period projection of key variables in simplified financial statements based on assumptions about growth, costs, and accounting methods. The Appendix provides a more detailed description of the model and a sample of the financial statements generated. Figure 4 gives the macro-logic.

Model Inputs and General Assumptions

1. A specification of an initial balance sheet from a 95-year lead-in period. Typical of many utilities, the model company has been capitalizing AFUDC during its lifetime and normalizing income tax benefits due to accelerated depreciation and the debt component of AFUDC. A 60/40 debt to equity ratio is assumed. The growth rate in demand during the lead-in period was 7%.

2. A specification of CWIP treatment. One of two methods is used:
   <ins>RB Method</ins>- includes the full amount of CWIP in the rate base and earns the same rate of return on CWIP as is earned on the rate base.
   <ins>CAP Method</ins>- excludes CWIP from the rate base, capitalizes an allowance computed as the product of CWIP and the allowed AFUDC rate. This return is credited to AFUDC income and added to the cost of CWIP.

3. A specification of the accounting procedures.

   (a) The income tax benefits from accelerated depreciation are normalized. Sum-of-the-years digits is used for taxes and straight line is used for rate purposes.

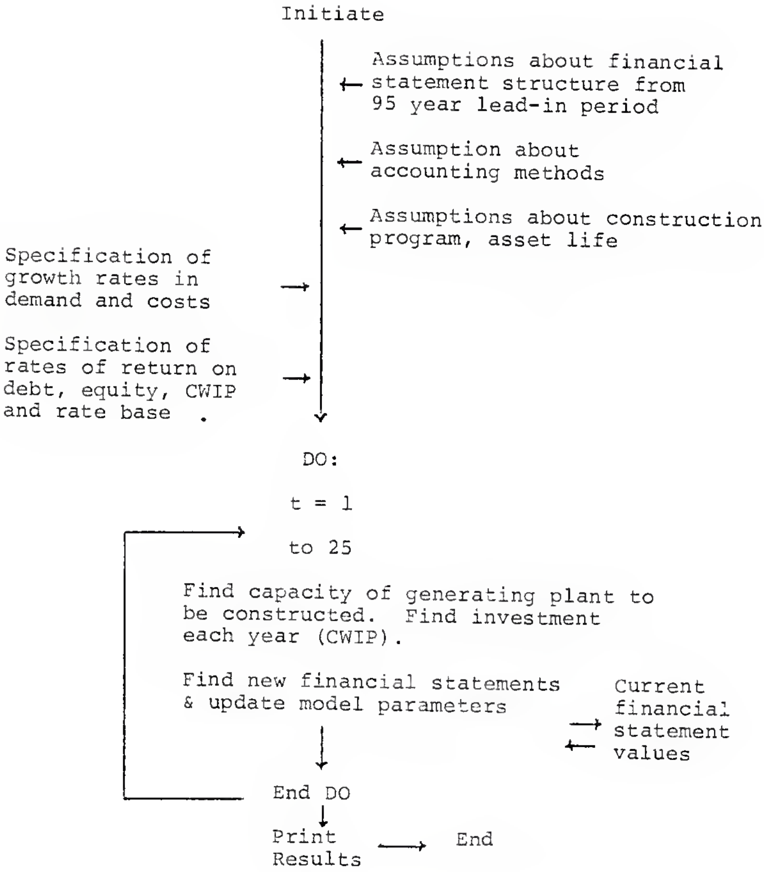

Initiate
Assumptions about financial statement structure from 95 year lead-in period
Assumption about accounting methods
Assumptions about construction program, asset life
Specification of growth rates in demand and costs
Specification of rates of return on debt, equity, CWIP and rate base
DO:
t = 1
to 25
Find capacity of generating plant to be constructed. Find investment each year (CWIP).
Find new financial statements & update model parameters
Current financial statement values
End DO
Print Results
End

FIGURE 4

MACRO-LOGIC OF CONSTRUCTION PROGRAM MODEL
OF AN ELECTRIC UTILITY

(b) The interest tax benefits due to the construction program are normalized by the CAP method. Taxes are deferred on the debt component of AFUDC.

(c) The CAP method does not compound on prior AFUDC. The annual charge for AFUDC is calculated by multiplying the balance in the CWIP account excluding any prior AFUDC by the AFUDC rate.

(d) The capitalized AFUDC is not deductible for tax purposes in depreciation expense when the constructed plant goes on-line; however, it is allowed for rate purposes. This results in a different valuation base for tax and rate purposes. This difference is amortized over the life of the plant by adjusting income tax expense and deferred taxes.

(e) Deferred taxes are subtracted from rate base assets for determination of the final rate base to be used for rate purposes.

4. A specification of the construction period and estimated life of the generating plants. It is assumed that it takes five years to construct a plant which will last thirty years. The investment in construction is assumed to be equal in each of the five years. One plant is always under construction.

5. A specification of anticipated growth in demand and costs: Operating costs are assumed to be a specified fraction of operating revenues. Construction costs are assumed to be constant with the justification that inflation is cancelled by economies of scale.

6. A specification of rates of return on debt, equity, CWIP and rate base. Flexible rates are assumed so that the allowed rate of return on the rate base is achieved. (See Table 3).

Model Outputs

1. Balance Sheet, Income Statement to Stockholder's, Income Statement to Internal Revenue Service.

2. Public Service Commission's rate base.

TABLE 3

RATES ASSUMED FOR SIMULATION

Allowed rate of return of equity: 13%

Allowed rate of return of debt: 9%

Allowed rate of return on rate base: 10.6%

Capital Structure 60/40 debt to equity

AFUDC rate: 10.6%

Tax rate: . .48

Growth rate in demand: 5.6%

Logic of Projection

The key idea is to start with a projected demand which determines the size of investment. The capacity of each new plant is such that five years after its completion the combination of plants will have the capacity to generate 10% above the estimated demand at that time. The construction program is continuous. Each plant has a five year construction period. As soon as one plant goes on-line, another is started. Internally generated funds are the first source of funds for the program. The remainder is from external sources in accordance with the prespecified capital structure of 60/40 debt/equity. Flotation costs are assumed to be zero, new stock is sold at book value and new debt is borrowed at the same rate as old.

The assumption of the accounting treatment of CWIP will directly affect operating income, deferred taxes and income taxes. The rate base and financial statements generated under the different accounting treatments will be used for analyses of cash flows, utility rates and financial ratios.

The simulation assumes that two firms, RB and CAP, start out in year 1, following a 95-year lead-in period, with a group of identical assets with capitalized AFUDC. For firm RB, the simulation is tantamount to a firm switching CWIP accounting methods in year 1 following the capitalization of AFUDC for 95 years.

The Interactive Financial Planning System (IFPS) was used to simulate two utilities using different CWIP accounting methods. The advantage of IFPS for the problem addressed is that it has subroutines for depreciation and amortization, and report generating capabilities which lend themselves to the modeling of the different accounting methods. The investment strategy model and the assumptions of the lead-in period are given in Appendix along with sample financial statements.

Results of Computer Simulation

Effect on Rate Base

The rate base is responsible for many relationships established by the simulation. Figure 5 shows that the rate base of firm RB is continually rising in a smooth pattern. This is due to the fact that the CWIP which is added is greater than the annual depreciation. The CAP firm has a fluctuating rate base. The fluctuations increase in intensity over time. The decline in the rate base pattern of the CAP method is due to the decreasing net plant caused by depreciation. The sharp increases are caused by plants going on-line and the accumulated CWIP being added to the rate base. This sawtooth pattern will be reflected in the utility rates, operating income, and cash flows of CAP companies.

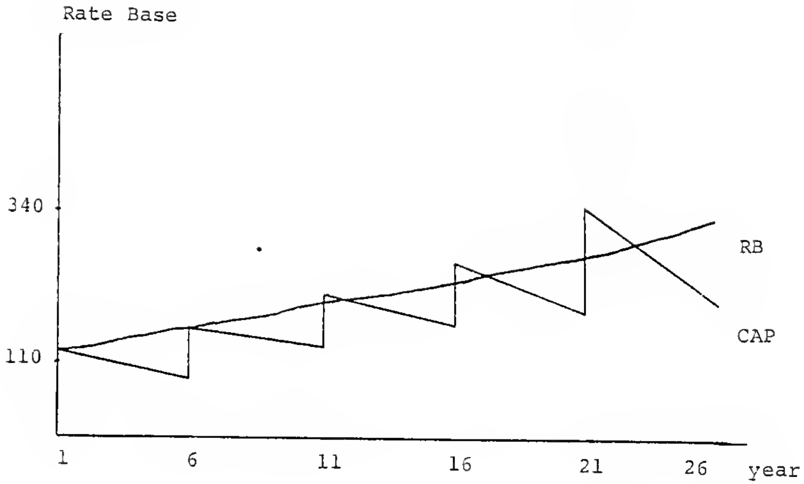


FIGURE 5

RATE BASES OF ALTERNATIVE CWIP METHODS

The relative sizes of the rate bases due to the alternative CWIP treatments over the simulation period can be seen in Table 4. In the last three construction cycles the RB firm has a lower rate base than the CAP firm during the beginning of the cycle. This is caused by CAP's prior AFUDC overwhelming the CWIP addition of the RB method.

Effect on Utility Rates

For the simulation period (25 years), five construction cycles of five years each were completed. Since the lead-in period (95 years) assumed the firm was capitalizing AFUDC, the RB firm reflects a switch in method for capitalization to rate base inclusion. (The fluctuations of the CAP firm become symetrical above and below the RB method following year 30 when the last of the lead-in period AFUDC effects are gone from the RB firm.)

Both methods result in fluctuating rates (Figure 6) however, the fluctuations of the CAP firm are three times greater than the RB firm. For the RB firm, the downward drift in each cycle is caused by the increased demand. This more than offsets the inclusion of CWIP in the rate base. The fluctuation in utility rates for firm RB, when a plant goes on line, is caused by the excess capacity. The downward drift in the CAP firm is due not only to the increase in demand, but also the decreasing rate base

TABLE 4

$\frac{\text{RB RATE BASE}}{\text{CAP RATE BASE}}$ RATIO OVER SIMULATION PERIOD

YR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ratio	1.00	1.15	1.23	1.35	1.47	1.00	1.08	1.16	1.26	1.39	.95	1.03	1.11	1.22	1.34	.92	1.00	1.09	1.19	1.30	.92	.99	1.07	1.16	1.28

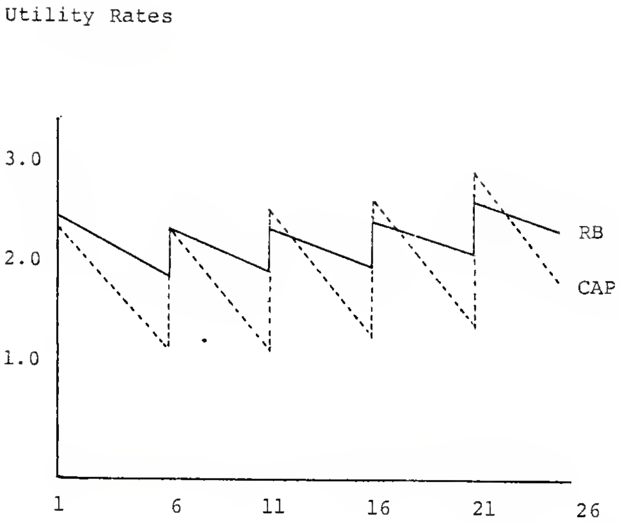


FIGURE 6

UTILITY RATES FOR ALTERNATIVE METHODS
OF CWIP ACCOUNTING

which makes the revenue requirement for capital cost less. (If demand growth were zero, rates would fall due to decreased capital cost.)

For the first two construction cycles (years 1 - 10) the rates for firm RB are greater than (except for year 6 when they are equal) for firm CAP. Thereafter, in the early years of the construction program, rates for firm CAP are higher than firm RB. The relative size of the differences in revenue requirements due to the alternative methods can be seen in Table 5. The greatest difference in the two methods occurs in the last year of the first construction cycle (year 5). The RB firm has a revenue requirement for capital costs (return on rate base, depreciation and income taxes) 1.47 times greater than the CAP firm while the total revenue requirements are 1.16 times greater.

Effects on Operating Income and Net Income

Figure 7 shows that the rate base pattern of the alternative methods is reflected in the operating income. The RB firm has an operating income which is smoothly rising, as is net income. The CAP firm has a sharply fluctuating operating income reflecting the rate base pattern. The reported net income for the CAP method rises in steps and is relatively smooth over the construction cycle even though the rate base is declining. This is caused by the AFUDC earnings which maintain the net income number even

TABLE 5

RATIO OF CAPITAL COSTS AND RATIO OF REVENUE REQUIREMENTS FOR ALTERNATIVE CWIP METHODS

$\frac{\text{RB CAPITAL COSTS*}}{\text{CAP CAPITAL COSTS}}$ RATIO

YR	1	2	3	4	5	6	7	8
Ratio	1.07	1.15	1.23	1.35	1.47	1.00	1.08	1.16
YR	9	10	11	12	13	14	15	16
Ratio	1.26	1.39	0.95	1.03	1.11	1.22	1.34	0.92
YR	17	18	19	20	21	22	23	24
Ratio	1.00	1.09	1.19	1.30	0.92	0.99	1.07	1.16
YR	25							
Ratio	1.28							

*Capital costs include return on rate base, depreciation and federal income taxes.

TABLE 5

(CONTINUED)

$\frac{\text{RB TOTAL REVENUE REQUIREMENTS}}{\text{CAP TOTAL REVENUE REQUIREMENTS}}$ RATIO

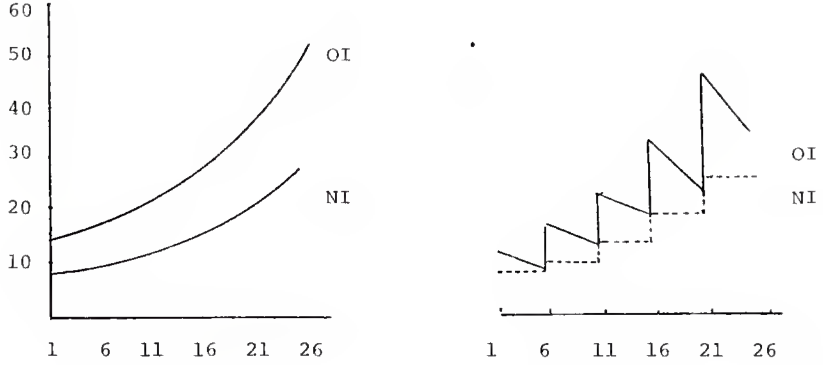
YR	1	2	3	4	5
Ratio	1.02	1.05	1.08	1.12	1.16

YR	6	7	8	9	10
Ratio	1.00	1.03	1.05	1.09	1.13

YR	11	12	13	14	15
Ratio	0.98	1.01	1.04	1.03	1.11

YR	16	17	18	19	20
Ratio	0.97	1.00	1.03	1.06	1.10

YR	21	22	23	24	25
Ratio	0.97	0.99	1.02	1.06	1.10



RB FIRM

CAP FIRM

FIGURE 7

OPERATING INCOME AND NET INCOME OF
ALTERNATIVE METHODS OF CWIP TREATMENT

though operating income is dropping. The sharp fluctuations noted in rates are reflected in the OI pattern of the CAP firm.

Tables 6 and 7 show the ratios of operating income and net income for the methods. The greatest difference is noted in the first construction cycle (years 1 - 5). The operating income in the last year of the cycle (year 5) is 1.81 times greater for the RB method, while the net income reflects only a difference of 1.18 times.

In the last construction cycle (year 21 - 25), the ratio of the operating incomes has decreased with the CAP firm having a greater operating income in the first two years of the cycle (years 21, 22) and a reported net income greater for the entire cycle. This reflects the cash realization of prior capitalized AFUDC and a larger rate base increment for the CAP firm.

Effect on Cash Flows after Dividends

The factors which cause the cash flow differences of the two methods are:

1. Different returns on capital due to different rate bases and, consequently, different utility rates.
2. Different depreciation expenses due to the CAP method containing capitalized AFUDC.

TABLE 6

$\frac{\text{RB OPERATING INCOME}}{\text{CAP OPERATING INCOME}}$ RATIO FOR ALTERNATIVE CWIP METHODS

YR	1	2	3	4	5	6	7	8
Ratio	1.12	1.25	1.41	1.59	1.81	.99	1.12	1.27
YR	9	10	11	12	13	14	15	16
Ratio	1.44	1.65	.91	1.04	1.19	1.36	1.56	.87
YR	17	18	19	20	21	22	23	24
Ratio	.99	1.14	1.31	1.52	.86	.97	1.11	1.28
YR	25							
Ratio	1.46							

TABLE 7

$\frac{RB_{NI}}{CAP_{NI}}$ RATIO FOR ALTERNATIVE CWIP METHODS

YR	1	2	3	4	5	6	7	8
Ratio	1.01	1.04	1.07	1.12	1.18	.90	.93	.97

YR	9	10	11	12	13	14	15	16
Ratio	1.02	1.08	.83	.86	.91	.96	1.02	.79

YR	17	18	19	20	21	22	23	24
Ratio	.82	.87	.93	.99	.78	.81	.85	.91

YR	25
Ratio	.98

3. Different income tax expenses due to the differences in net income, depreciation expense and deferred taxes on the debt component of AFUDC.

Figure 8 shows the pattern of the cash flows for the two methods. The RB method results in a cash flow pattern which is a step function. The steps are caused by the increased depreciation expense when a plant goes on-line. Cash flows are greater for this method for all years except for the first year of the last three construction cycles (Table 8, years 11, 16, and 21). This reflects the cash realization of prior AFUDC for the CAP firm.

The fluctuations in the CAP method cash flows are caused by the changes in operating income due to the rate base pattern. The peaks occur when plants go on-line and greater capital allowances and depreciation expenses are included in the rates. Since the model assumes actual demand is equal to anticipated demand and instant rate relief, the going on-line of a plant reflects an improvement in cash flows for CAP firms. This is frequently not the case. If demand is not sufficient and rate relief not received when a plant goes on-line, the simulation results are not substantiated.

Effect on Internally Generated Funds as a Percentage of Annual Investment in CWIP

It has been projected (12) that in the next twenty years electric utilities will need to generate 40% of their

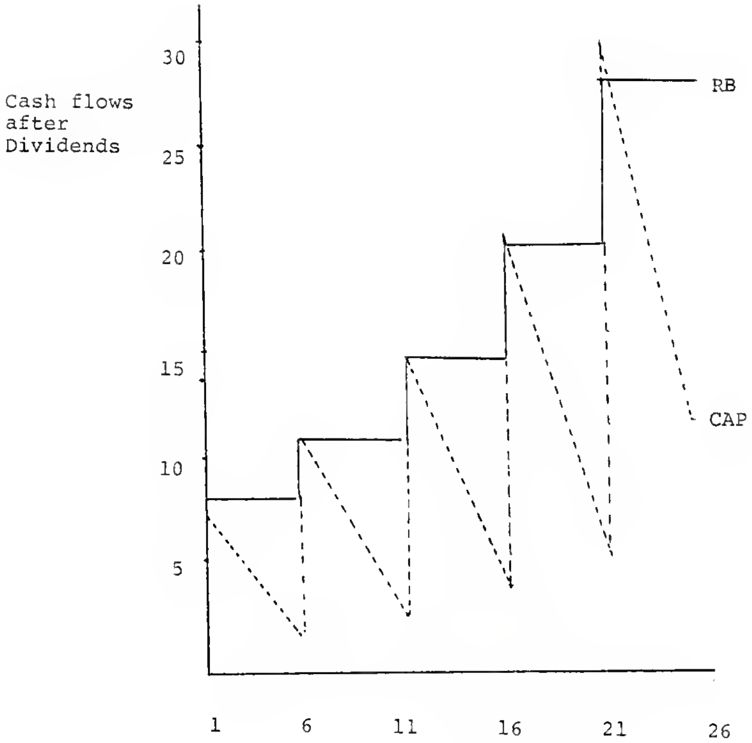


FIGURE 8

CASH FLOWS AFTER DIVIDENDS

TABLE 8

$\frac{\text{RB CASH FLOWS}}{\text{CAP CASH FLOWS}}$ RATIO OF ALTERNATIVE CWIP METHODS

YR	1	2	3	4	5
Ratio	1.09	1.27	1.55	1.96	2.72
YR	6	7	8	9	10
Ratio	1.03	1.20	1.45	1.85	2.57
YR	11	12	13	14	15
Ratio	.99	1.16	1.40	1.78	2.47
YR	16	17	18	19	20
Ratio	.96	1.12	1.36	1.73	2.41
YR	21	22	23	24	25
Ratio	.95	1.11	1.34	1.71	2.40

funds internally. Since 1970 the industry average has been around 30%. The results of the simulation showed an average consistent with the past industry average for the CAP method, but not meeting the target percentage. The RB method exceeds the target for all years.

The internally generated funds are derived from three principal sources: (1) retained earnings, (2) depreciation and amortization, and (3) deferrals of normalized items. Since the CWIP treatment affects all three, the patterns for percentage of funds generated internally for the alternative methods are different over the individual construction cycles and over the simulation period. Figure 9 shows the ratio of cash flows after dividends as a percentage of CWIP for the two methods. The RB firm (Figure 9A shows a constant ratio of internally generated funds for each year of the five year construction period, however, each cycle results in a slightly lower percentage. The first five year construction cycle (year 1 - 5) had 63% of the funds generated internally, while the last cycle (year 21 - 26) had 55% generated internally.

The CAP firm (Figure 9B) results in a declining percentage over the five year cycle, but is constant for each corresponding year in all cycles. When the annual investment in CWIP includes AFUDC, the first year of the construction program 53.3% of the funds are generated internally. The percentage decreases to 14.8% in the fifth

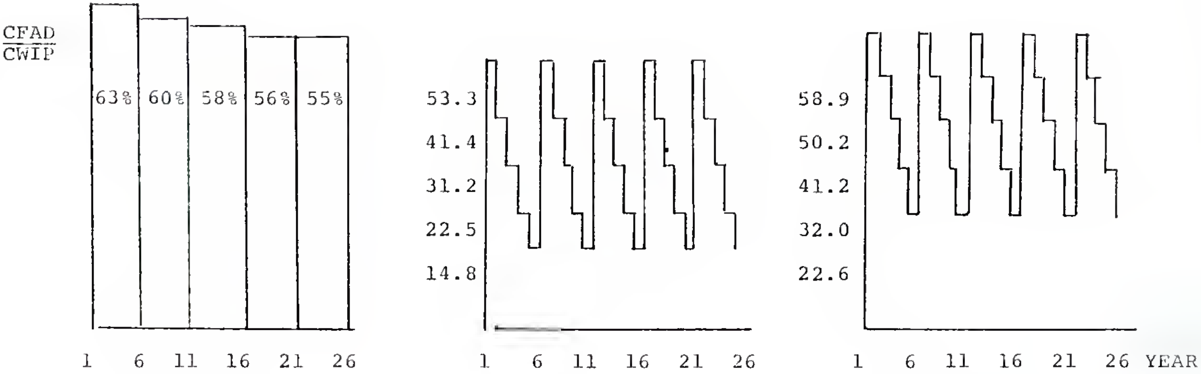


Figure 9A
RB Firm

Figure 9B
CAP Firm (CWIP
including AFUDC)

Figure 9C
CAP Firm (CWIP
excluding AFUDC)

FIGURE 9

INTERNALLY GENERATED FUNDS AS A PERCENTAGE OF ANNUAL INVESTMENT IN CWIP FOR ALTERNATIVE CWIP TREATMENTS year of the program. The average over the five year construction program is 32.64%. Investment exclusive of AFUDC is shown in Figure 9C.

The different patterns can be explained by Figure 10 which shows the annual investment in CWIP and cash flows after dividends for the alternative methods. The CAP firm (Figure 10B) has a smoothly increasing investment in CWIP if AFUDC is considered, or a step pattern if AFUDC is excluded. The cash flows after dividends are sharply fluctuating as discussed earlier. This difference in cash flows leads to a different percentage each year for the ratio.

The RB firm (Figure 10A) has a step function for both CWIP investment and cash flows. The CWIP pattern reflects the simulation assumption of equal annual out-of-pocket investment cost exclusive of the capital cost. Consequently, an equal ratio is obtained for each year of the cycle.

Effect on Times Interest Earned Ratio (TIE)

The times interest earned ratio is affected by the CWIP treatment since part of AFUDC is generally excluded from income available for coverage. There is an appreciable difference between the range of the CAP method and the RB method over the simulation period. The range of the RB firm is between 2.61 - 3.28 while the CAP range is 1.36 - 2.62 (Figure 11). The fluctuations over the

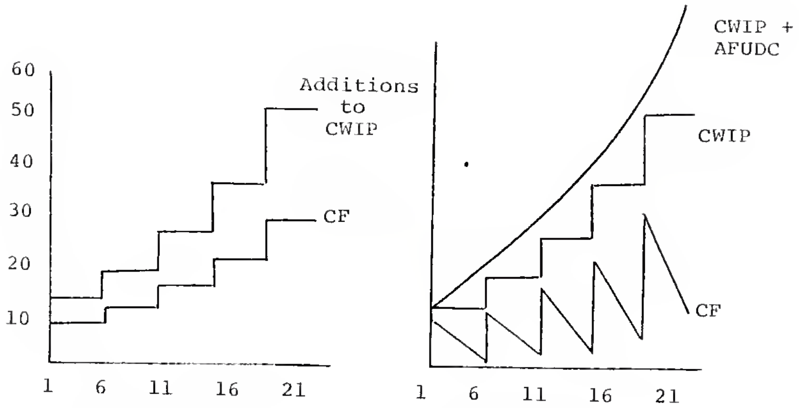


FIGURE 10A

RB METHOD

FIGURE 10B

CAP METHOD

FIGURE 10

ANNUAL INVESTMENT IN CWIP AND CASH FLOWS AFTER DIVIDENDS FOR ALTERNATIVE CWIP METHODS

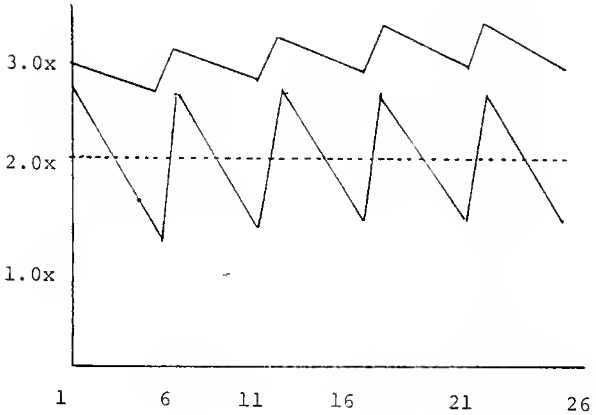


FIGURE 11

TIMES INTEREST EARNED RATIO FOR ALTERNATIVE CWIP METHODS

TABLE 9

TIMES INTEREST EARNED RATIOS FOR THE ALTERNATIVE CWIP TREATMENTS

YR	1	2	3	4	5
RB	2.89	2.83	2.76	2.69	2.61
CAP	2.62	2.28	1.96	1.65	1.36
CAP*	2.64	2.36	2.01	1.71	1.51

YR	6	7	8	9	10
RB	3.06	1.97	2.88	2.80	2.70
CAP	2.62	2.28	1.96	1.65	1.36
CAP*	2.64	2.36	2.01	1.71	1.51

YR	11	12	13	14	15
RB	3.18	3.08	2.97	2.87	2.77
CAP	2.62	2.28	1.96	1.65	1.36
CAP*	2.64	2.36	2.01	1.71	1.51

YR	16	17	18	19	20
RB	3.27	3.15	3.03	2.92	2.81
CAP	2.62	2.28	1.96	1.65	1.36
CAP*	2.64	2.36	2.01	1.71	1.51

YR	21	22	23	24	25
RB	3.28	3.19	3.07	2.95	2.84
CAP	2.62	2.28	1.96	1.65	1.36
CAP*	2.64	2.36	2.01	1.71	1.51

*10% AFUDC/NI is included for coverage calculations.

construction cycles are also appreciably different. The greatest fluctuation in the RB method for any cycle is .46 TIE, while the CAP method results in fluctuations of 1.26 TIE. For the CAP firm, the TIE ratio is below 2.0 for three out of the five years in the construction cycle. Table 9 shows a comparison of the ratios over the simulation period. Since a small percentage of AFUDC/NI is frequently allowed for coverage purposes, the TIE ratio for a 10% inclusion is also given.

Effect of Not Compounding AFUDC

The model constraint is that the allowed rate of return on the rate base is the realized rate of return. Prior AFUDC is not compounded. Consequently, each period some assets in addition to those financed by deferred taxes are not receiving a return. This will affect the rate of return on equity since the return on debt is fixed by contract. The magnitude of this effect can be seen in Table 10. The difference in the allowed and realized rates for each year is the allowed rate of return on the rate base times the allowance for funds used during construction (ka X AFUDC). This can be readily seen by looking at the theory of the model. Using the following definitions:

ka = allowed return on rate base which is a weighted average of k_d, the cost of debt, and k_c, the cost of equity.

k_{AFUDC} = allowed return on CWIP

ka = k_{AFUDC}

TABLE 10

EFFECT ON RETURN ON EQUITY OF NOT COMPOUNDING PRIOR AFUDC

Years in Construction Cycle	1	2	3	4	5
Return on Rate Base	10.6	10.6	10.6	10.6	10.6
Return on Equity Allowed	13.00	13.00	13.00	13.00	13.00
Realized	12.72	12.18	11.51	10.70	9.80
Difference	.28	.82	1.49	2.3	3.2

RB = Rate Base

TA = Total Assets

DT = Deferred Taxes

$TA = RB + CWIP$

$RB = TA - CWIP - AFUDC - DT$ (for the non-compounding capitalizing method)

The total book return each period, in theory, is:

$$kaRB + k_{AFUDC}CWIP = ka(TA - DT)$$

Substituting for RB and recalling that $ka = k_{AFUDC}$

$$ka(TA - CWIP - AFUDC - DT) + kaCWIP = ka(TA - DT)$$

$$kaAFUDC \neq 0.$$

The difference between the return allowed on the rate base and CWIP and the return allowed on assets exclusive of deferred taxes will be kaAFUDC. Since the debt return is fixed, this effect is reflected in the equity return.

Common Dividends Paid as a Percentage of Net Income Available for Common Excluding AFUDC

Dividends as a percentage of net income excluding AFUDC has increased dramatically for the utility industry since 1960. In 1974 and 1975, more than 100% of cash earnings from operations was paid in dividends. The CAP firm shows how this situation would be a likely occurrence. Table 11 shows dividends as a percentage of net income excluding AFUDC and AFUDC as a percentage of net income. As can be seen in the last year of the construction program, greater than 100% of the net income is AFUDC.

TABLE 11

DIVIDENDS AS A PERCENTAGE OF NET INCOME EXCLUDING AFUDC AND AFUDC AS A PERCENTAGE OF NET INCOME CAP FIRM

Year in the Construction Cycle	1	2	3	4	5
$\frac{\text{DIV.}}{\text{NI - AFUDC}}$	89%	120%	184%	405%	undefined
$\frac{\text{AFUDC}}{\text{NI}}$	21%	42%	62%	83%	105%

Effect of AFUDC on Normalized Accounting

The treatment of tax-timing difference due to depreciation methods and interest tax benefit due construction are normalized in the simulation. This is the professional standard today except for those public utilities which are regulated on a flow-through basis. A problem developed during the early stages of the model construction which points up what may be a problem for firms which capitalize AFUDC.

A "permanent" difference arises due to different valuation bases for tax and rate purposes. Capitalized AFUDC is included in the depreciation base for rate purposes when constructed plants go on-line. Revenue requirements for depreciation are based on this base. However, the AFUDC element is not allowed for tax purposes. The depreciation tax shield is not available for AFUDC on the utility constructed plant.

The difference in valuation bases results in a need to adjust income tax expense if normalization accounting is employed. The customary method of calculating deferred taxes will not work. The customary method involves multiplying before tax net income per books times the statutory rate to get the income tax expense. The before tax income figure was based on a depreciation expense which is greater than allowed by the Internal Revenue Service, since the AFUDC element cannot be deducted. Consequently, income tax expense will be understated for revenue requirements over the life of the plant by t(tax rate) X AFUDC (capitalized on completed plant). Some states allow taxes to be deferred on the debt portion of AFUDC (Florida, for example). This procedure will result in the income tax expense over the life of the plant being understated by the tax rate times the equity component of AFUDC if the customary method is used. For the simulation, this difference was amortized over the life of the plant by adjusting income tax expense and deferred taxes. This problem is addressed again in Chapter V.

Effect of Regulatory Lag on Simulation Results

The assumption of the model was that utility rates were flexible. This is highly unlikely in the real world. When this assumption is relaxed and replaced with fixed rates, two important relationships are noted:

(1) The fluctuation which was necessary in utility rates for the flexible rate case is transferred to the rates of return on equity when a fixed utility rate is used. Since the operating cost increases at the same rate, due to increasing demand, regardless of whether the rate is fixed or flexible, and the debt holders receive a fixed rate of return, the fluctuation is passed on to the equity holders.

(2) Proportionately, the fluctuation in the rate of return on equity with the fixed utility rate is much greater than the fluctuation in utility rates with the flexible rate. The fluctuation is magnified with fixed utility rates since the base over which this fluctuation is spread is smaller. Equity holders must absorb all the fluctuations rather than sharing it with debt holders. With flexible rates, the fluctuation in utility rates is spread over the entire base.

Referring to Figure 12A, it can be seen that when utility rates are flexible and the rate of return on equity fixed, utility rates fall over the construction cycle for both firms RB and CAP. The sharp downward fluctuation for firm CAP is due to demand and AFUDC rising. Operating income is being replaced by AFUDC to keep the return on equity fixed. For firm RB the much smaller fluctuation is due to demand increase. If utility rates were fixed and return on equity allowed to vary over the cycle, (Figure 12B) the rate of return on equity would rise sharply for firm CAP, since both operating income due to demand increase and rising AFUDC would be reflected. For firm RB, the equity return would increase much less sharply due to demand increase. The large positive fluctuation in utility rates which occurs when a plant goes on-line and the return on equity is fixed for firm CAP would result in a large drop in rate of return on equity with fixed utility rates. The demand increase cannot compensate for the lost AFUDC earnings and higher expenses for the new plant. The same pattern, but to a smaller degree, would occur for firm RB due to higher depreciation expense caused by the new plant not being in the old fixed utility rate.

Summary and Conclusion

1. The simulation shows that the greatest differences in the two methods of accounting for CWIP occur in the last

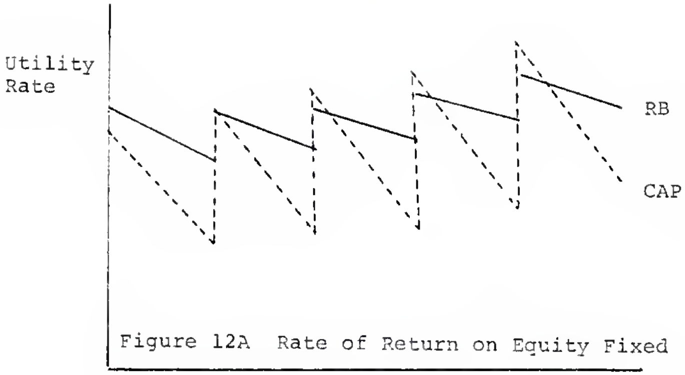


Figure 12A Rate of Return on Equity Fixed

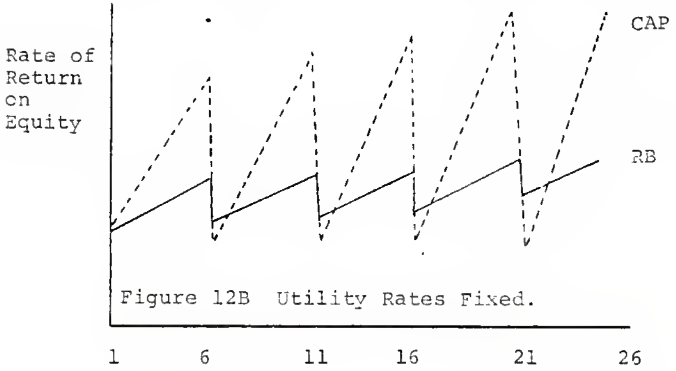


Figure 12B Utility Rates Fixed.

FIGURE 12

THE EFFECT OF REGULATORY LAG ON RETURN ON EQUITY:
THE RELATIONSHIP BETWEEN FIXED UTILITY RATES AND
FIXED RETURN ON RATE BASE

year of the first construction cycle after a switch has been made from capitalizing AFUDC to including CWIP in the rate base. The effects of AFUDC last for the life of the corresponding plant.

2. With the relatively conservative assumptions of the model, it appears doubtful if firms which capitalize AFUDC as the only return on CWIP can meet the industry's projected target of 40% internally generated funds.

3. The pattern of firm CAP's operating income versus net income over the construction cycle points up a disclosure problem for the accountant. While operating income could be dropping drastically, the net income figure remains stable.

4. The possible magnitude of the effect of not compounding when AFUDC is capitalized is brought out by the simulation. In addition the difference in tax valuation bases and utility rate valuation bases for AFUDC containing plants was illustrated.

5. The relationships and causes of fluctuations in return on equity and utility rates are the major contribution of the simulation. By referring to Chapter III for the sensitivity of utility rates to changes in the rate base, the fluctuations in the simulation results can be explained for a fixed return on equity. When regulatory lag is imposed on these results and utility rates are considered fixed, the effects of the different methods on equity return can be explained.

Limitations of this simulation are:

1. Inflation was not built into the model. Prices were considered constant. This does not affect the usefulness of the study, since anticipated inflation in revenues and costs will cancel.
2. Economies of scale were not considered.
3. The model is deterministic. Uncertainty is not considered for prices, demand, or regulatory factors, due to the lack of known probability distributions.

CHAPTER V

THE EFFECT OF AFUDC ON THE MARKET TO BOOK RATIO AND THE PRICE TO EARNINGS RATIO OF ELECTRIC UTILITIES

The effect of AFUDC capitalization on the market to book (P/B) ratio was ascertained using multiple regression analysis. The theoretical justification for the models stems from the assumptions that capital markets are imperfect and that stocks are valued by the investor as the present value of expected future dividends. Another measure of the investor's attitude towards AFUDC may be the price to earnings ratio (P/E) of firms which have a high percentage of AFUDC in their earnings figure. The mean value of the P/E ratio for the two groups ranked on AFUDC/NI (highest 30% and lowest 30%) for the period 1960-1975 was tested to determine if there was a significant difference between the groups.

Regression Models

The theory of underlying the multiple regression models is that of an imperfect capital market. Recognition that capital markets are not perfectly competitive requires more than measuring share yield to determine the cost of capital. In Perfectly Competitive Capital Markets[1] the cost of capital is independent of the level and financing of the firm's investment and is equal to the leverage-free yield on the firm's stock. The yield increases with leverage because investors are indifferent between leverage on personal and corporate account. The tradition theory of the cost of capital departs from the Perfectly Competitive Capital Market theory only in the leverage assumption. The weighted average cost of capital, according to this theory, is a decreasing function of the utility's leverage rate (23).

Gordon (23) has shown that according to both theories, the market-book ratio for a utility's stock is equal to one when (1) the allowed return on assets is equal to the theory's cost of capital, and (2) the coupon (imbedded) interest rate on outstanding debt is equal to the current interest rate. He established that the difference between the current interest rate and the imbedded rate did not affect the traditional cost of capital, and with the Perfectly Competitive Capital Market theory, the cost of capital is a decreasing function of the ratio of the current rate to the coupon rate. His conclusion was, that under both theories, the allowed rate of return is above (below) the cost of capital when the market-book ratio is above (below) one.

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[1] The Perfectly Competitive Capital Markets theory was hypothesized by Modigliani and Miller, "The Cost of Capital, Corporate Finance, and the Theory of Investment," American Economic Review 48 (June 1958): 261-97.

However, Gordon's work shows that empirically neither the traditional nor the Perfectly Competitive Capital Market theories can be substantiated with utility stocks in regard to leverage and investment policies. Imperfect capital markets best describe the return required by these stocks. Yield is shown to be an increasing function of the firm's retention and stock financing rates.

The basic theory of all the models in regard to expected rate of return is the discounted cash flow theory of stock valuation which states the price an investor will pay for a share in the present value of the expected future dividends. Consequently, dividend yield (BKYLD) and dividend growth (GROBR) are important variables in all the models. The growth term should reflect investor's expectations into the indefinite future, but data are available only for the past which presents the problem of testing ex ante models with ex post data. At present, there is no solution to this problem.

Variables used in the models to reflect risk are AFUDC as a percentage of NI (AFD), flow-through treatment for accelerated depreciation (FT) and equity ratio (EQR). The first two could be expected to reflect regulatory risk and the last, financial risk.

Basic Assumptions and Tests for Multiple Regression Models

The general linear regression model employed is

$$Y_i = \alpha_0 + \alpha_1 X_{i1} + \alpha_2 X_{i2} + \dots \alpha_{p-1} X_{i,p-1} + \varepsilon_i$$

where: $\alpha_0, \alpha_1, \dots, \alpha_{p-1}$ are parameters

$X_{i1}, X_{i2}, \dots, X_{i,p-1}$ are nonstochastic variables

ε_i are independent $\sim N(0, \sigma^2)$

$i = 1, \dots, n$

This general linear regression model implies that observations Y_i are independent normal variables, with mean $E(Y_i)$ and with a constant variance σ^2.

To test whether the response function is an appropriate response surface for the data at hand the F test for goodness of fit is used (33).

Sample Selection and Data Base. The 100 companies followed by Solomon Brothers in their monthly publication, Electric Utility Common Stock Market Data were used for the regression models. This report gives data on market price, book values, dividends, earnings and return on equity.

Model Variables

The definitions of model variables and their mnemonic codes are given in Table 12. The rationale for use of these variables is as follows:

> P/B ratio (PB) is the dependent variable in all of the models. Both the Perfectly Competitive Capital Market theory and the traditional capital market

TABLE 12

VARIABLE DEFINITIONS

Variable		
P/B	Price to Book Ratio	$= \frac{\text{Av. High, Low and Last Price}}{\text{Book Value per Share (BVS)}}$
BKYLD	Book Yield of Dividends	$= \frac{\text{Dividends Per share (DIV)}}{\text{BVS}}$
GROBR	Retention Growth Rate	= Retention Rate X Expected Return on Equity (EROE) $= (1 - \frac{\text{DIV}}{\text{BVS X EROE}}) \text{ X EROE}$
	*EROE = 0.4 ROE(T) + 0.3 ROE(T-1) + 0.2 ROE(T-2) + 0.1 ROE (T-3)	
EQR	Equity Ratio	$= \frac{\text{Common Equity}}{\text{Total Capital}}$
AFD	Allowance for Funds During Construction	$= \frac{\text{AFUDC}}{\text{Net Income}}$
FT	Accounting Treatment for Accelerated Depreciation	= 1.0 for flow-through 0 for normalized.

---

*EROE, expected return on equity, is assumed to be a weighted average of past returns on equity. The most recent return is weighted the heaviest at 40% and decreasing 10% for each of the three years prior.

theory state that this ratio is equal to one when the allowed rate of return is equal to the cost of capital.

Dividend yield (BKYLD) and Growth (GROBR) are basic variables to the discounted cash flow theory of stock valuation.

Equity ratio (EQR) is an indicator of the risk of leverage on the cost of capital.

Flow-through accounting (FT) indicates that the firm must flow-through to present consumers the tax benefits of accelerated depreciation. Brigham and Pappas (10) have shown that investors view these firms as riskier. Therefore, this can be used as a risk variable (dummy).

AFUDC/NI ratio (AFD) is an indicator of the firm's cash position, and is hypothesized by this research as a risk variable. This ratio is used in the models in two forms. When used as a quantitative variable the mnemonic code AFD is used. When used as a dummy variable, the mnemonic is AFDL1.

Hypotheses on the Effect of AFUDC on the Market to Book Ratio

Three hypotheses are tested concerning the effect of AFUDC as a percentage of NI on the market to book ratio. Expressed in first the null form and then the alternative, they are:

H_{o1}: The market to book ratio of electric utilities is not a decreasing linear function of the AFUDC/NI ratio.

H_{a1}: The market to book ratio of electric utilities is a decreasing linear function of the AFUDC/NI ratio.

H_{o2}: The significance of AFUDC/NI ratio as an explanatory variable of the market to book ratio is not a function of a threshold level.

H_{a2}: The significance of AFUDC/NI ratio as an explanatory variable of the market to book ratio is a function of a threshold level.

H_{o3}: Firms which have $\leq$ 15% AFUDC/NI do not have significantly higher market to book ratios than firms which have greater than 15% AFUDC/NI.

H_{a3}: Firms which have $\leq$ 15% AFUDC/NI have significantly higher market to book ratios than firms which have greater than 15% AFUDC/NI.

Hypothesis 1

H_{o1}: The market to book ratio of electric utilities is not a decreasing linear function of the AFUDC/NI ratio.

To test this hypothesis, three models were considered:

$$P/B = \alpha_o + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 EQR + \alpha_4 AFD + \alpha_5 FT \quad (1)$$

$$P/B = \alpha_o + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 EQR + \alpha_4 AFD \quad (2)$$

$$P/B = \alpha_o + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 AFD + \alpha_4 FT \quad (3)$$

Table 13 shows the parameter estimates for the models with 1972 data. After running models (1) and (2) for several years, a growing correlation between AFD and EQR was noted. Consequently, Model (3) was chosen for the eight year analysis.

Model 3 has fairly good explanatory power with few independent variables. The cross-sectional estimates of the parameters for 1970-1977 are shown in Table 14. The correlation matrix (Table 15) shows very little correlation between the independent variables.

TABLE 13

PARAMETER ESTIMATES FOR MULTIPLE REGRESSION MODELS 100 ELECTRIC UTILITIES, 1972

Model	Dependent Variable P/B	α_0	α_1 BKYLD	α_2 GROBR	α_3 EQR	α_4 AFD	FT	R^2	F(Y,df)
(1)		-0.315	13.150	11,780	0.351	-0.210	-0.040	.6588	36.307
		(-1.279)	(8.718)	(8,783)	(0.675)	(-1.778)**	(-0.872)	(0.1888)	
(2)		-0.396	13.506	12.049	0.424	-0.190		.6561	45.308
		(-1.744)	(9.316)	(9.234)	(0.8269)	(1.643)*		(0.189)	
(3)		-0.1912	13.144	11.938		-0.231	-0.044	0.6428	45.531
		(-1.165)	(8.740)	(9.058)		(-2.031)**	(-0.996)	(0.1883)	

*Level of significance = .10

**Level of significance = .05

TABLE 14

CROSS-SECTIONAL ESTIMATES OF THE PARAMETERS FOR 1970-1977 100 ELECTRIC UTILITIES

Model: $P/B = \alpha_0 + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 AFD + \alpha_4 FT$

Year	α_0	α_1	α_2	α_3	α_4	Corr. R^2 (S.E.E.)	F(4.95)
1970	-0.3947 (-2.410)	13.470 (8.789)	17.259 (9.922)	-0.0849 (-0.466)	-0.0685 (-1.349)	0.6562 (0.2209)	48.235
1971	-0.2802 (-1.693)	13.981 (9.209)	14.158 (9.161)	-0.1554 (-1.131)	-0.0411 (-0.870)	0.6599 (0.200)	48.802
1972	-0.1912 (-1.165)	13.144 (8.740)	11.938 (0.058)	-0.2307** (-2.031)	-0.0444 (-0.996)	0.6428 (0.1883)	45.531
1973	-0.1166 (-1.243)	11.385 (12.662)	6.6214 (8.480)	-0.0326 (-0.590)	0.0269 (-0.639)	0.7044 (0.1157)	59.978
1974	-0.1057 (-1.551)	9.3763 (13.795)	4.7072 (8.776)	-0.0812** (-2.764)	-0.0607 (-3.033)	0.7361 (-0.08778)	70.028
1975	-0.1987 (-2.832)	11.242 (15.809)	5.1486 (8.748)	-0.1411** (-3.144)	-0.0796 (-3.916)	0.7536 (0.09031)	76.894
1976	-0.1138 (-1.477)	11.129 (14.615)	5.2641 (7.701)	-0.0717* (-1.462)	-0.0522 (-2.494)	0.7064 (0.09275)	60.546
1977	0.01427 (0.255)	10.998 (18.533)	2.3815 (5.455)	-0.0731** (-2.457)	-0.0524 (-3.623)	0.7845 (0.06467)	91.121

The t-ratio for the coefficient is shown in parenthesis below the coefficient. The standard error of the estimate is in parenthesis below the R^2.

*Level of significance = .10

**Level of significance = .05

TABLE 15

CORRELATION MATRICES FOR MODEL:

$$P/B = \alpha_0 + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 AFD + \alpha_4 FT$$

100 ELECTRIC UTILITIES 1970 = 1977

	BKYLD	GROBR	AFD	FT
BKYLD70	1.0000			
GROBR70	-0.0172	1.0000		
AFD70	-0.0719	-0.1325	1.0000	
FT	-0.2139	-0.1180	0.0452	1.0000
BKYLD71	1.0000			
GROBR71	-0.0687	1.0000		
AFD71	-0.1484	-0.2315	1.0000	
FT	-0.2096	-0.2199	-0.0087	1.0000
BKYLD72	1.0000			
GROBR72	-0.1793	1.0000		
AFD72	-0.2454	-0.1295	1.0000	
FT	-0.1973	-0.1924	-0.0546	1.0000
BKYLD73	1.0000			
GROBR73	-0.2067	1.0000		
AFD73	-0.1405	-0.3542	1.0000	
FT	-0.2069	-0.1608	0.1132	1.0000
BKYLD74	1.0000			
GROBR74	-0.3034	1.0000		
AFD74	-0.1703	-0.0724	1.0000	
FT	-0.1296	-0.0792	-0.0725	1.0000
BKYLD75	1.0000			
GROBR75	-0.3606	1.0000		
AFD75	-0.0478	0.0293	1.0000	
FT	-0.1044	0.0198	0.1016	1.0000
BKYLD76	1.0000			
GROBR76	-0.3478	1.0000		
AFD76	0.0482	-0.1225	1.0000	
FT	-0.1465	0.0941	0.0474	1.0000
BKYLD77	1.0000			
GROBR77	-0.2182	1.0000		
AFD77	0.0774	-0.1222	1.0000	
Ft	0.0093	-0.0606	0.0645	1.0000

A comparison of the trend of the mean value of AFUDC/NI for the sample and the coefficient for the Model 3 is shown in Table 16.

Conclusion. The null hypothesis cannot be rejected for 1970, 1971 and 1973. The null can be rejected for 1972, 1974, 1975, 1976, and 1977. The AFUDC/NI ratio has a significant negative effect on the P/B ratio for these years.

The effect of AFUDC on the P/B ratio can be translated into the effect on the cost of capital for the sample in the following manner.

1. Determine a required ROE which will give a P/B = 1 when the sample contains AFUDC. This can be done by determining a book yield (BKYLD) and dividing by the payout ratio (1-b). $\text{ROE} = \frac{\text{BKYLD}}{(1-b)}$

   Substituting mean values for the independent variables except BKYLD and 1 for the dependent variable the required BKYLD for 1972 is calculated:

   $$P/B = \alpha_1 + \alpha_2 \text{BKYLD} + \alpha_3 \text{GROBR} + \alpha_4 \text{AFD} + \alpha_5 \text{FT}$$

   $$1 = (-\ .1912) + 13.14\ (\text{BKYLD}) + 11.94\ (.04398) + (-\ .2307)$$
   $$(.25158) + (-\ .0442)(.28)$$

   $$13.14\ (\text{BKYLD}) = .7366$$

   $$\text{BKYLD} = .056057$$

The payout ratio for 1972 was .644; therefore the required $\text{ROE} = \frac{\text{BKYLD}}{(1-b)}$

$$\text{ROE} = \frac{.056057}{.644}$$

$$\text{ROE} = 8.7045$$

TABLE 16

MEAN VALUE OF AFUDC/NI RATIO AND REGRESSION COEFFICIENT FOR AFD, 100 PUBLIC UTILITIES, 1970-1977

Model 3: $P/B = \alpha_0 + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 AFD + \alpha_4 FT$

Year	Mean	Std. Dev.	α_3	t-ratio
1970	.17285	.12258	-0.08494	-0.466
1971	.21633	.15274	-0.15538	-1.313
1972	.25158	.17611	-0.23069	-2.031**
1973	.32183	.39050	-0.03259	-0.590
1974	.36649	.30811	-0.08115	-2.764**
1975	.30322	.20241	-0.14114	-3.144**
1976	.29252	.19089	-0.07171	-1.462*
1977	.33804	.21986	-0.07305	-2.457**

*Level of significance = .10

**Level of significance = .05

2. Remove the effect of AFUDC on the P/B ratio by assuming 0 AFUDC in the regression equation.

    $13.14\ (BKYLD) = .7366 - .05804$

    $BKYLD = .05232$

    and required ROE = 8.1241

3. The effects of AFUDC on the cost of capital for 1972 has been

    $8.7045 - 8.1241 = .5804$

The effects on the cost of capital can be seen in Table 17.

Hypothesis 2

H_{o2}: The significance of AFUDC/NI ratio as an explanatory variable of the market to book ratio is not a function of a threshold level.

To test this hypothesis, two methods were employed. The first method involves the cross-sectional regressions of Model 2 with the sample partitioned into various percentages of AFUDC/NI. The second method was to consider the evolution of significance of the cross-sectional coefficients for the entire sample over time as the mean AFUDC/NI ratio rose from 17 percent in 1970 to 34 percent in 1977 for Model 3 (Hypothesis 1).

TABLE 17

THE EFFECT OF AFUDC ON THE COST OF CAPITAL 100 ELECTRIC UTILITIES

Model: $P/B = \alpha_1 + \alpha_2 BKYLD + \alpha_3 GROBR + \alpha_4 AFD + \alpha_5 FT$

Year	Required BKYLD with AFUDC	Required BKYLD without AFUDC	Payout Ratio	Required ROE with AFUDC	Required ROE without AFUDC	Effect of AFUDC, %
1970	5.2016	5.0966	.749	6.9405	6.7952	.145
1971	5.2571	5.0167	.662	7.9367	7.5737	.363
1972	5.6057	5.2328	.644	8.7045	8.1241	.580
1973	7.3710	7.2789	.650	11.3413	11.1996	.141
1974	10.418	10.0946	.676	15.4112	14.8609	.550
1975	9.61785	9.23721	.693	13.8786	13.3293	.549
1976	8.72817	8.5397	.710	12.2932	12.0277	.266
1977	8.58487	8.36034	.711	12.0744	11.7586	.316

Using Model 2

$$P/B = \alpha_o + \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 EQR + \alpha_4 AFD \qquad (2)$$

the sample of 100 utilities was broken down into various percentages of AFUDC/NI (Table 18). For the group with AFUDC/NI $\leq$ 15%, the AFD coefficient was positive, but not significant which would appear to support the hypothesis that at low percentages, the P/B was not affected. As the percentage is increased to $\leq$ 20%, the sign of the coefficient changes, but is not significant. This would indicate the threshold may be approaching. Between 20% and 25% of the coefficient gains significance, indicating that the threshold is in this range. This technique can be criticized because of the differences in sample size of the groups. The degrees of freedom are different for each regression. It could be argued that significance develops due to increasing sample size as well as increasing AFUDC/NI.

Referring back to Table 16 it can be seen that, employing Model 3, the AFUDC/NI ratio became significance between 1971 and 1972 when the mean value was between 22-25%. However, the standard deviations were large, which makes the accuracy of this method questionable, even though the results point to the same range as the cross-sectional analysis.

Conclusion. The null hypothesis cannot be rejected due to limitations of the testing methods. The methods

TABLE 18

PARAMETER ESTIMATES FOR VARYING PERCENTAGES OF AFUDC/NI: 100 ELECTRIC UTILITIES, 1972

Model: $P/B = \alpha_0 + \alpha_1 BKYLD + \alpha_2 GROBR72 + \alpha_3 EQR72 + \alpha_4 AFD72$

AFUDC/NI	d.f.	α_0	α_1	α_2	α_3	α_4	corr.R^2(S.E.E.)
$\leq$ 15%	25 (30)	-0.7706 (-2.231)	18.049 (7.379)	18.305 (6.057)	-0.45692 (-0.535)	1.3767 (1.294)	0.7684 (0.2125)
$\leq$ 20%	36 (41)	-0.4301 (-1.247)	15.764 (6.665)	16.894 (6.20)	-0.48195 (-0.5637)	-0.29138 (-0.4455)	0.6940 (0.2307)
$\leq$ 25%	50 (55)	-0.3746 (-1.292)	15.579 (8.300)	15.715 (7.196)	-0.40350 (-0.547)	-0.57713* (-1.450)	0.6628 (0.2092)
$\leq$ 30%	60 (65)	-0.2688 (-0.988)	14.914 (8.465)	14.108 (7.533)	-0.31606 (-0.486)	-0.70143** (-2.296)	0.6467 (0.2055)
$\geq$ 34%	25 (30)	-0.1769 (-0.333)	7.9134 (2.970)	10.106 (6.170)	1.0618 (0.999)	-0.04037 (-0.193)	0.5815 (0.1336)
$\overline{Y}$ = .25158	95	-0.3965	13.51	12.05	0.4238	-0.1900	0.6416
σ=(0.17611)	(100)	(-1.744)	(9.316)	(9.234)	(0.8269)	(-1.643)*	(0.1886)

(Continued)

TABLE 18

(CONTINUED)

Correlation Matrix

	BKYLD72	GROBR72	EQR72	AFD72
BKYLD72	1.0000			
GROBR72	-0.1793	1.0000		
EQR72	0.0607	0.2384	1.0000	
AFD72	-0.2454	-0.1295	-0.2783	1.000

The t-ratio is shown in parenthesis below the coefficient. The standard error of the estimate is in parenthesis below the R^2.

† = number of companies in sample.

employed point to the range of 20 to 25% as a threshold level.

Hypothesis 3

H_{o3}: Firms which have $\leq$ 15% AFUDC/NI do not have significantly higher market to book ratios than firms which have greater than 15% AFUDC/NI

To test this hypothesis a dummy variable (AFDL1) is employed. This method allows the introduction of a variable without specification as to the exact functional form. If a difference is suspected between two groups, in this case a group with a high percentage AFUDC/NI (>15%) and a group with a low percentage ($\leq$15%), a binary variable can be used. This method does not result in a quantifying coefficient for each level of AFUDC/NI as is the case for other independent variables. The assumption is that the two groups differ only in the intercept term and the coefficients for the quantitative variables are equal. The equality of these subset coefficients can be tested with the Chow test (11).

The model used to test this hypothesis is:

$$P/B = \alpha_1 \text{ BKYLD} + \alpha_2\text{GROBR} + \alpha_3\text{EQR} + \alpha_4\text{AFDL1}.$$

This can be expressed as the general regression model;

$$Y = \alpha_1 X_{i1} + \alpha_2 X_{i2} + \alpha_3 X_{i3} + \alpha_4 D + \varepsilon_i.$$

When AFUDC/NI is $\leq$ 15%, D = 1,

the response function is:

$$E(Y) = \alpha_4 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3.$$

When AFUDC/NI is > 15%, D = 0,
the response function is:

$$E(Y) = \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3.$$

The α_4 intercept indicates how much higher or lower the response function is for the model including the dummy variable. The assumption is that the subset of slope coefficients is equal for the two regressions, i.e.,

$$\alpha_1 = \gamma_1, \ \alpha_2 = \gamma_2, \text{ and } \alpha_3 = \gamma_3.$$

Chow has shown that this equality can be tested with the F statistic. By applying the least squares estimation method to both groups of data, and the pooled data, the sum-of-squares residuals from the three regressions can then be used to form the statistic:

$$\frac{(SSE_c - SSE_1 - SSE_2)/K}{(SSE_1 + SSE_2)/n + m - 2K} \sim F_{K,\ n+m-2K}$$

Table 19 shows that from 1970 through 1973 the coefficients of the subset were not equal and the dummy variable model should not be used. For 1974 through 1977, the F statistic indicates that equality of the subset coefficients cannot be rejected and the model assumptions are substantiated.

The model should also be rejected for 1970 and 1971 on the basis of the F test for lack of fit, which tests for a relationship between P/B and the set of independent variables (Table 20). The statistic is satisfactory after 1971, but the 3.0547 and 0.5599 values for 1970 and 1971 make it impossible to reject the null that all the coefficients equal zero.

TABLE 19

CHOW TEST FOR EQUALITY OF SUBSET COEFFICIENTS

Level of Significance $\alpha = .01$

Models: $P/B = \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 EQR + \alpha_4 AFDL1$

$P/B = \gamma_1 BKYLD + \gamma_2 GROBR + \gamma_3 EQR$

Year	$F_{3.96}$	Conclusion
1970	8.8028	Reject null*
1971	19.0867	Reject null
1972	10.0439	Reject null
1973	5.7769	Reject null
1974	1.5842	Do not reject null
1975	2.1462	Do not reject null
1976	1.6944	Do not reject null
1977	2.4245	Do not reject null

*Null hypothesis is that $\alpha_1 = \gamma_1$, $\alpha_2 = \gamma_2$, and $\alpha_3 = \gamma_3$.

TABLE 20

CROSS-SECTIONAL ESTIMATES OF PARAMETERS FOR 1970-1977
100 Electric Utilities

Model: $P/B = \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 EQR + \alpha_4 AFDL1$

AFDL1 = 1, when AFUDC/NI $\leq$ 15% = 0 otherwise

Year	α_1	α_2	α_3	α_4	R^2	F(3.96)
1970	2.434 (1.221)	-4.091 (-2.169)	3.658 (11.519)	0.1291 (1.516)	-0.1055 (0.4138)	-3.0547
1971	2.761 (1.489)	-4.198 (-3.241)	3.693 (11.178)	0.089 (1.194)	0.0172 (0.3565)	0.5599
1972	10.441 (6.743)	9.935 (6.054)	-0.034 (-0.079)	0.160 (2.953)	0.4659 (0.24164)	27.9184
1973	9.828 (13.951)	6.130 (8.293)	-0.020 (-0.098)	0.083 (3.13)	0.728 (0.1140)	85.7156
1974	7.852 (11.755)	4.513 (6.932)	-0.776 (-0.410)	0.035 (1.398)	0.638 (0.1056)	56.3865
1975	9.406 (13.215)	4.373 (6.020)	-0.291 (-1.401)	0.055 (2.174)	0.6645 (0.107)	63.3660
1976	10.028 (14.776)	4.094 (5.641)	-0.061 (-0.313)	0.175 (0.738)	0.6838 (0.1006)	69.1915
1977	10.024 (20.127)	1.949 (3.852)	0.165 (1.277)	0.036 (1.981)	0.7372 (0.0755)	89.7726

The t-ratio is shown in parenthesis below the coefficient.
The standard error of the estimate is in parenthesis below the R^2.

The positive sign of the AFDL1 coefficient is due to the set up of the model. The dummy variable equals one when firms have $\leq$ 15% AFUDC/NI. The results of this regression agree with the results for hypothesis 1 which employed Model 3. While Model 3 resulted in AFUDC/NI ratio being significant for more years, the years of greatest significance (after 1972) were 1974, 1975, and 1977 which substantiates the dummy model.

Conclusion. The null hypothesis cannot be rejected for the years 1971 and 1976 on the basis of the t-statistic. However, the inequity of the subset coefficients make the use of the model invalid for the years 1970 through 1973. The model is valid only for the years 1974-1977. The null can be rejected for the years 1974, 1975 and 1977. The P/B ratio is significantly higher for firms which have $\leq$ 15% AFUDC/NI compared to firms which have > 15% AFUDC/NI for these years.

When the effects of AFUDC on the P/B ratio are translated to effects on cost of capital employing the dummy variable model, the mean values for the two groups, AFUDC/NI $\leq$ 15% and AFUDC/NI > 15%, are used instead of the overall sample mean. The required book yield and equity returns for 1975 and 1977 are in a similar range as those calculated for the model used to test Hypothesis 1 (Table 16), but are higher in 1974, as can be seen in Table 21. A possible explanation for this is

TABLE 21

THE EFFECT OF AFUDC ON THE COST OF CAPITAL, 100 ELECTRIC UTILITIES

Model: $P/B = \alpha_1 BKYLD + \alpha_2 GROBR + \alpha_3 EQR + \alpha_4 AFDL1$

$AFDL1 = 1, AFUDC.NI \leq 15\%$

$AFDL1 = 0, AFUDC/NI > 15\%$

Year	Required BKYLD with AFUDC > 15%	Required BKYLD with AFUDC ≤ 15%	Payout Ratio	Required ROE with AFUDC > 15%	Required ROE with AFUDC ≤ 15%	% Effect
1974	13.9562	13.5871 (23)*	.676	20.6452	20.0990	.5462
1975	9.9505	9.7650 (26)*	.693	14.3586	14.0909	.2677
1977	8.5190	8.0630 (25)*	.711	11.9958	11.3403	.6554

*Number of firms with ≤ 15% AFUDC/NI.

multicollinarity between the equity ratio and AFUDC noted earlier. The independent variables employed for the dummy variable model are different from those used to test Hypothesis 1 due to econometric problems. Model 2 was modified to test Hypothesis 3 instead of Model 3. There are two reasons for this. First, an attempt was made to use Model 3 with AFD being a dummy variable instead of a quantitative variable. The computer could not invert the matrix. A possible explanation is that the dummy variables for FT and AFD were defined in a manner as to establish multicollinarity. Second, had Model 3 been used with AFD as a dummy variable, the Chow test would have been complicated by the use of two dummies in the same Model. For each year, the number of required regressions would have doubled.

The multicollinarity which existed for Model 2 when AFD and EQR were quantitative variables is eliminated when AFD is a dummy. Consequently, the resulting model has bookyield, growth and equity ratio as quantitative independent variables with AFUDC as a qualitative variable.

Price/Earnings Ratio Trend

The historical trend of the P/E ratios for electric utilities having high and low percentages of AFUDC in their income figure may provide a measure of investor's attitudes towards AFUDC. To test this hypothesis the trend since 1960 was tracked for two groups of firms in the following manner.

Test

1. Firms are classified as normalizing or flow-through, and then within each group they are ranked according to their ratio of AFUDC/earnings. This is done for each year from 1960-1975.

2. The lowest ranking 30% of the firms and the highest ranking 30% of the firms are then used as the low and high AFUDC samples for the specific year. The companies in the sample change each year. However, the percentage (# of firms) in the sample is constant. Since 70 normallizing firms are listed on Compustat, the sample consisted of 21 of the lowest ranking AFUDC/Earnings firms and 21 of the highest ranking AFUDC/Earnings firms. Forty-seven flow-through firms are listed. Consequently, the flow-through samples consisted of 14 of the lowest and 14 of the highest ranking AFUDC/Earnings.

3. A t-test is run on the means of the samples from the low and high rankings to determine if there is a significant difference between the mean value of their P/E ratios. The null hypothesis is:

$$H_o\colon \mu_{\substack{\text{high}\\ \text{AFUDC}}} = \mu_{\substack{\text{low}\\ \text{AFUDC}}}$$

Results

The t test shows that for flow-through and normalizing firms in the early 60's there was a significant difference between firms with high ratio of AFUDC/Earnings and a low ratio (Figures 13 and 14, Tables 22 and 23). Firms with the higher AFUDC had higher P/E ratios.

Beginning in 1966 flow-through firms start experiencing a shift in P/E relative to percent AFUDC (Figure 13). In 1966 and 1967 there is no significant difference between high and low AFUDC. In 1968 and 1969, a return to the prior relationship occurs with high AFUDC and high P/E. However, in 1970, 1971, and 1972, there is a lack of significant difference. In 1974, the trend is reversed with higher AFUDC resulting in lower P/E. This continues in 1974 (even though, not statistically significant). The early 1960's relationship of the high AFUDC group having the high P/E may be explained as follows: The percentage AFUDC/NI for the high group was around 10% (Table 22). Consequently, CWIP did not create appreciable cash flow problems, and may have been viewed as a growth indicator. By 1967 the relative positions of the two groups had changed and the mean value of AFUDC/NI had risen to 13%. This trend continued to a high of 61% in 1974. Another possible explanation would be the change in regulatory environment.

Normalizing firms (Figure 14) experience statistically different mean P/E values for the years from 1960-1970. Unlike the flow-through companies which experience several cross-overs, the normalizing firms have only one shift in the relationship between the high AFUDC group and the low group, which occurs in mid 1971 and is not significant until 1974, at which time the low AFUDC firms had a higher P/E than the high AFUDC group. The delay in the cross-over as compared to the flow-through firms might be attributed to a better cash flow position.

TABLE 22

MEAN P/E RATIOS, MEAN AFUDC/NI, T-STATISTICS AND SIGNIFICANCE LEVELS FOR TWO GROUPS OF FOURTEEN FLOW-THROUGH ELECTRIC UTILITIES. GROUPS REPRESENT THE HIGHEST 30% AND LOWEST 30% OF COMPUSTAT'S FLOW-THROUGH ELECTRIC UTILITIES RANKED ON AFUDC/NI. 1960 - 1975

	Mean P/E		Mean AFUDC/NI			
Year	Lowest 30%	Highest 30%	Lowest 30%	Highest 30%	T	α
1960	17.9903	17.8868	.0053	.1067	.0600	
1961	19.4773	24.8440	.0076	.0920	2.8313	.005
1962	18.8316	21.1502	.0040	.1047	1.6006	.100
1963	19.0522	21.4759	.0037	.0923	1.8254	.050
1964	18.7928	21.5285	.0063	.0900	2.0933	.025
1965	17.7505	20.3508	.0079	.0920	2.3170	.025
1966	15.2400	16.2560	.0092	.0935	1.2324	
1967	13.8498	13.5528	.0209	.1290	.3314	
1968	14.0371	14.8645	.035	.1870	1.3746	.100
1969	10.6837	11.3642	.0300	.2640	1.5590	.100
1970	12.0299	12.4390	.0580	.3390	.9625	
1971	11.9465	12.7164	.0680	.4350	.6289	
1972	10.4632	10.8177	.0720	.4300	.8242	
1973	9.0860	7.7212	.0720	.4930	1.7524	.050
1974	5.8202	5.3091	.0770	.6090	1.0032	
1975	7.2245	7.5878	.0990	.5280	.7585	

TABLE 23

MEAN P/E RATIOS, MEAN AFUDC/NI, T-STATISTICS AND SIGNIFICANCE LEVELS FOR TWO GROUPS OF TWENTY-ONE NORMALIZING ELECTRIC UTILITIES. GROUPS REPRESENT THE HIGHEST 30% AND LOWEST 30% OF COMPUSTAT'S NORMALIZING ELECTRIC UTILITIES RANKED ON AFUDC/NI.
1960 - 1975

	Mean P/E		Mean AFUDC/NI			
Year	Lowest 30%	Highest 30%	Lowest 30%	Highest 30%	T	α
1960	16.9522	20.4232	.0057	.1216	2.2376	.025
1961	20.3581	24.3713	.0053	.1006	2.7844	.005
1962	18.5879	21.9254	.0045	.1134	2.4755	.010
1963	19.1722	21.5883	.0054	.0881	2.2139	.025
1964	18.8303	22.7048	.0050	.0760	3.2862	.005
1965	16.4604	21.5880	.0046	.0800	4.4182	.005
1966	14.5696	17.2289	.0106	.1078	2.3349	.010
1967	13.2315	14.8225	.0142	.1372	1.6834	.05
1968	14.3920	15.8690	.0176	.1647	1.7567	.05
1969	11.2552	12.5871	.0192	.2200	1.7035	.05
1970	11.8843	13.1731	.0198	.2988	1.7524	.05
1971	11.1915	11.8741	.0217	.3972	1.1507	
1972	11.1434	10.6655	.0517	.4619	.7234	
1973	8.8387	8.7284	.0465	.5438	.2052	
1974	7.1594	6.2122	.0675	.7346	1.8059	.050
1975	8.0663	7.9891	.0558	.5324	.1620	

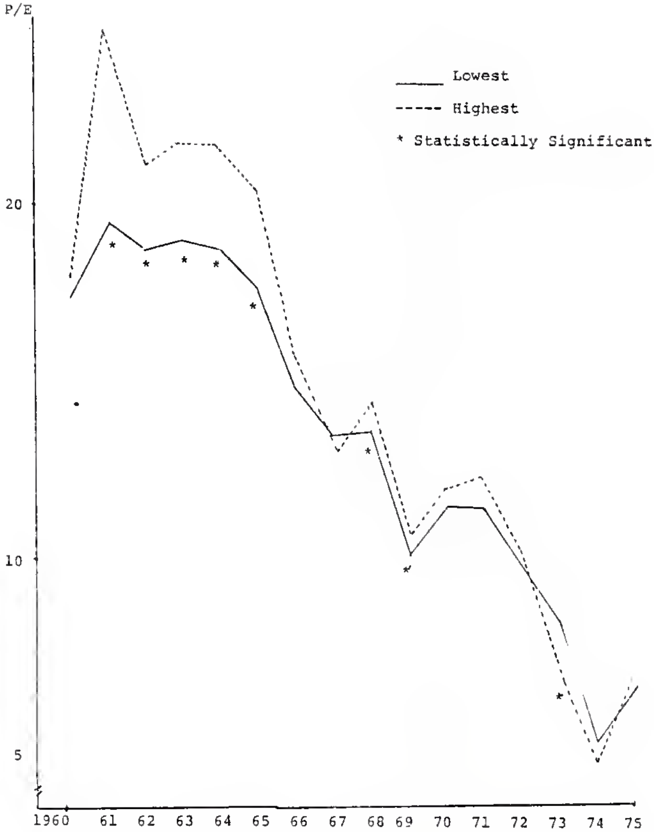


FIGURE 13

MEAN P/E RATIOS FOR TWO GROUPS OF FOURTEEN FLOW-THROUGH ELECTRIC UTILITIES. GROUPS REPRESENT THE HIGHEST 30% AND LOWEST 30% FOR COMPUSTAT FLOW-THROUGH ELECTRIC UTILITIES. 1960 - 1975.

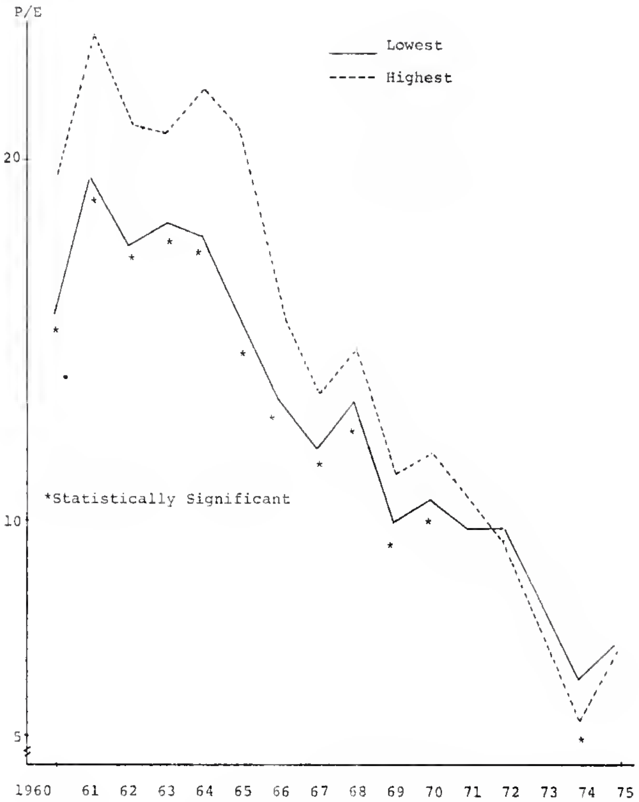


FIGURE 14

MEAN P/E RATIOS FOR TWO GROUPS OF TWENTY-ONE NORMALIZING ELECTRIC UTILITIES. GROUPS REPRESENT THE HIGHEST 30% AND LOWEST 30% RANKED ON AFUDC/NI FOR COMPUSTAT NORMALIZING ELECTRIC UTILITIES. 1960 - 1975.

Summary

This chapter has shown that:

(1) The market to book ratio of electric utilities was a decreasing linear function of the AFUDC/NI ratio in 1972, 1974, 1975, 1976, and 1977. The AFUDC/NI ratio had a significant negative effect on the P/B ratio in 1972, 1974, 1975, 1976, and 1977. The effect on the cost of capital, respectively was .58%, .55%, .55%, .27%, and .32%.

(2) If there is a threshold level before AFUDC affects the market to book ratio it appears to be below 25% AFUDC/NI.

(3) The group of electric utilities which have $\leq$ 15% AFUDC/NI have a significantly higher market to book ratio in 1974, 1975 and 1977 than electric utilities which have > 15% AFUDC/NI.

(4) In the early seventies there was shift in the average P/E of electric utilities which had high percentage of AFUDC/NI relative to firms with low percentage of AFUDC/NI. In the sixties, firms with high AFUDC also had high P/E's. This trend shifted in the opposite direction in the early seventies as the average AFUDC/NI increased and the economy felt the impact of the Arab oil embargo.

Limitations of this study are:

(1) A ratio was used as a variable. Consequently, when a change occurs it can be caused by a change in the

numerator or denominator. The AFUDC could be increasing relative to NI or the NI could be falling.

(2) The vintage of the AFUDC could be a factor in whether the market discounts it. A firm could have high AFUDC income due to a plant being near completion. If the regulatory climate is favorable for the necessary rate increase and demand appears to be as anticipated, the AFUDC earnings may not be discounted by the market. A possible extension of this research would be to stratify the sample according to vintage of AFUDC and regulatory climate, if possible.

CHAPTER VI

CURRENT ELECTRIC UTILITY PRACTICES

Current practices were determined by researching current literature and Federal Energy Regulation Commission orders, talking with members of the industry and the Florida Public Service Commission accounting staff, and conducting questionnaire surveys of the principal association of investor-owned electric utility companies and the fifty state public service commissions. This chapter is divided into two parts. The first part describes the methods used and how they are implemented. It includes the rationale behind the FPC's AFUDC rate, the financial reporting of construction accounting over recent years, alternative methods of treating the interest tax benefits from borrowed construction funds and their effects on rates of return, and the effect of different asset valuation bases due to AFUDC on cumulative deferred taxes. The second part describes the results of the questionnaire surveys. It includes the actual CWIP accounting practices, methods used to determine the amount of CWIP to include in the rate base, the treatments of interest tax benefits and compounding prior AFUDC, the effects of restrictions on AFUDC for interest coverage purposes, and opinions on AFUDC accounting.

CWIP Accounting Methods

Basically three methods and combinations of these three methods are used in practice. They are (1) the capitalization of AFUDC, (2) the inclusion of CWIP in the rate base with offsetting AFUDC credits to revenue requirements, and (3) the inclusion of CWIP in the rate base without AFUDC credits to revenue requirements.

The Capitalization of AFUDC

The CWIP is excluded from the rate base and no cash return is realized on construction funds. The AFUDC amount is calculated by multiplying a CWIP balance by an AFUDC rate. The amount is then capitalized as an addition to CWIP (a current asset) and AFUDC income recognized for a like amount. A cash return for construction funds starts being realized, by way of depreciation and rate base, only after the project is completed and in-service.

CWIP in Rate Base with Offsetting AFUDC Credits to Revenue Requirements

A CWIP balance, either including or excluding accumulated prior AFUDC, is included with net plant-in-service in the rate base, along with other assets considered "used and useful." This sum is multiplied by the allowed rate of return on the rate base to arrive at the capital expenses for current revenue requirements. This amount is then reduced by an AFUDC credit which is calculated by multiplying a CWIP balance, either including or excluding accumulated prior AFUDC, by an AFUDC rate.

This method can result in a current cash return on CWIP. The current cash return is a function of

1. The differential between the AFUDC rate and the allowed return on the rate base
2. The CWIP balance included in the rate base and the CWIP balance used for the calculation of the current AFUDC credit against revenue requirements (the compounding of prior AFUDC issue).

The AFUDC amount is capitalized as an addition to CWIP and AFUDC income recognized for the like amount. A cash return for this amount will be realized in the future during the useful life of the constructed asset through depreciation and rate base.

CWIP in the Rate Base

The AFUDC is not calculated. The CWIP is included in the rate base. This CWIP balance does not contain AFUDC since none is recognized. This method can result in a current cash return at the same rate as plant-in-service and other "used and useful" assets.

Combinations

Regulatory commissions frequently permit combinations of the above three methods. Rate base treatment may be allowed for certain types of assets such as conversion facilities and pollution abatement equipment, projects past a specified percentage complete, or CWIP equal to a certain dollar amount, while the remaining CWIP accrues AFUDC. The methods used to determine the amount to allow in the rate base are discussed later. The current cash return is obviously determined by the amount allowed in the rate base and the method by which AFUDC is accrued (Method 1 or 2 above).

Implementation of Methods Which Capitalize AFUDC

The AFUDC is calculated by applying a particular AFUDC rate to a balance composed of construction expenditures accumulated from work orders during a certain time period. The AFUDC rate, the expenditure base and the time period have all been controversial, and to a large extent the controversies continue.

Time Period and Expenditure Base

Two time periods are involved, the duration of the capitalization period and the calculations within this period. The duration of the AFUDC capitalization period is addressed first. Many expenditures are necessary prior to the actual construction, such as environmental studies, land and permit acquisitions, preliminary engineering and business surveys. Major disagreements have centered over the limits of when the construction period begins and ends. The determination of the boundaries, for the most part, has been determined by the commissions and courts. In at least nineteen jurisdictions, the respective commissions have specifically defined this period (39). The FPC has issued many opinions and orders regarding this matter. In December 1964, the FPC issued FPC Accounting Release Number AR-5 (16) to offer accounting guidelines for the proper capitalization period. The Release was sufficiently general to avoid specifically limiting the capitalization period to arbitrary boundaries and to permit case by case determination:

> Federal Power Commission
> Accounting Release Number AR-5
>
> Interest during construction may be capitalized starting from the date that construction costs are continuously incurred on a planned progressive basis. Interest should not be accrued for the period prior to: (1) the date of issuance of the preliminary permit by the Commission of a licensed hydroelectric project; and (2) the date of the application to the Commission for a certificate to construct facilities by a natural gas company. Interest accruals may be allowed by the Commission for the period prior to the above dates if so justified by the company. No interest should be accrued during periods of interrupted construction unless the company can justify the interruption as being reasonable under the circumstances.
>
> Capitalization of interest stops when the facilities have been tested and are placed in service or ready for service. This would include those portions of construction projects completed

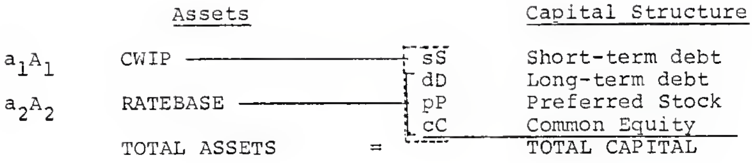
> and put into service although the project is not fully completed. Should the test period exceed thirty days, the company must submit full particulars and justification for an extension of such period to the Commission in Accordance with Plant Instruction 9D (16).

Commissions in the past appear to have based the period on not how long it actually was, but on how long it should have been, assuming that the preliminary activities were performed on a reasonably continuous basis (39).

Within the construction period a monthly time period is usually employed against an actual dollar expenditure base. One of three balances is used by most firms (37):

1. Month's ending balance
2. Average of the month's beginning and ending balance
3. Average of the month's beginning balance plus one-half of the current month's expenditures.

The second and third method will yield the same balance, but the first will result in a different base. The pattern of expenditures would justify the use of one method over the others. If construction expenditures are incurred at the beginning of the month, then the first method would be appropriate. The other two methods would be more justifiable if expenditures are distributed over the entire month. For the most part, regulatory commissions have left the choice up to the individual utilities (37).



Allowed Rate of Return = Cost of Capital

$$a_1A_1 + a_2A_2 = sS + dD + pP + cC$$

a_1 = AFUDC rate
A_1 = CWIP as % total assets
a_2 = Allowed rate of return on rate base
A_2 = Rate base as % total assets
s = short-term debt rate
S = short-term debt as % total capital
d = long-term debt rate (embedded)
D = long-term debt as % total capital
p = preferred rate (embedded)
P = preferred stock as % total capital
c = cost of common equity
C = common equity as % total capital

FIGURE 15

SIMPLIFIED BALANCE SHEET AND RELATIONSHIPS OF ALLOWED RATE OF RETURN TO THE TOTAL COST OF CAPITAL

The actual expenditures included also vary. Direct job overheads are generally included, but indirect overheads and prior AFUDC are usually at the discretion of commisions. Land acquired for construction, even though it is a non-depreciable asset, usually has AFUDC capitalized on it. A company can capitalize AFUDC on the total construction expenditure balance, including the land costs, and spread this allowance only over the depreciable asset accounts. However, if the land is classified as "land held for future use" it does not accrue AFUDC (37).

AFUDC Rate

Historically, a great deal of controversy has existed between the electric utilities and commissions regarding the rate to be applied in capitalizing AFUDC. In February 1977, following extensive hearings, the Federal Power Commission issued Order Number 561 (18), applicable to firms under their jurisdiction, which established a uniform formula for determining the maximum rates to be used in computing AFUDC and accordingly amended the Uniform System of Accounts. The purpose of this order was to establish a method for determining a maximum rate for AFUDC that would permit utilities to achieve a rate of return on total operations which would not omit important categories of capital cost or result in double counting of the same capital cost. Employing the procedure used in rate cases, a method for determining AFUDC was devised which essentially looks at the total capital structure of the utility. Figure 15 shows the basic assumption used to analyze the problems involved. It is assumed that the utility's permanent capital structure plus short-term borrowing is equal to the sum of its rate base plus CWIP. In rate proceedings, short-term debt typically has not been included in rate of return computations for cost of service purposes on the grounds that such debt is temporary and is used essentially for construction. Order Number 561 adopts the approach that short-term debt cost should be capitalized through AFUDC. Many respondents objected to the weight given short-term debt in the rule and argued that short-term debt is not necessarily the first source of construction funds as indicated by the formula in Figure 16. Even though it is acknowledged that it is impossible to trace the source of funds used for various corporate purposes, it was necessary to handle short-term debt in this manner due to the prodecure for handling the permanent capital structure in rate proceedings. This method will not result in double counting of the same capital cost or omit categories.

Accounting System and Financial Reporting

The accounting systems used by public utilities aid in the regulatory process. They usually contain definitions of each account and the bases, along with the general form and sequence of the major financial statements.

I. Gross allowance for borrowed funds used during construction:

$$k_d^{CWIP} = k_{ds} \left(\frac{D_s}{CWIP}\right) + \left[k_{dl} \left(\frac{D_l}{S + P + D_l}\right) \left(1 - \frac{D_s}{CWIP}\right)\right]$$

$$A_i = \begin{matrix}\text{Short-term}\\ \text{debt cost}\end{matrix} \left(\begin{matrix}\text{\% CWIP that*}\\ \text{is short-}\\ \text{term debt}\end{matrix}\right) + \left[\begin{matrix}\text{Long-term}\\ \text{debt cost}\end{matrix} \left(\begin{matrix}\text{\% Long-term debt}\\ \text{of long-term}\\ \text{Capital structure}\end{matrix}\right) \left(\begin{matrix}\text{\% CWIP that}\\ \text{is not short-}\\ \text{term debt}\end{matrix}\right)\right]$$

*All short-term debt is assumed to apply to CWIP.

A_i = Gross allowance for borrowed funds used during construction

D_s = Average short-term debt (estimated for the current year with appropriate adjustments as actual data becomes available)

k_{ds} = Short-term debt interest rate (estimate for the current year and revised if necessary)

D_l = Long-term debt (actual book balances as of the end of the prior year)

k_{dl} = Long-term debt rate (weighted average*)

P = Preferred stock (actual book balances as of the end of the prior year)

k_p = Preferred stock cost rate (weighted average*)

(Continued)

FIGURE 16

FEDERAL ENERGY REGULATORY COMMISSION
FORMULA FOR CALCULATION OF COMPONENT RATES OF ALLOWANCE FOR FUNDS USED DURING CONSTRUCTION

S = Common equity (actual book balance as of the end of the prior year)

k_c = Common equity cost rate (last rate granted)

CWIP = Average balance CWIP plus nuclear fuel in process of refinement, conversion, enrichment and fabrication (estimated for the current year with revision if necessary).

II. Allowance for other funds used during construction:

$$k_e^{CWIP} = \left(1 - \frac{D_s}{CWIP}\right) \left[k_p \left(\frac{P}{S + P + D_1}\right) + k_c \left(\frac{S}{S + P + D_1}\right)\right]$$

$$A_c = \begin{pmatrix}\text{% CWIP that} \\ \text{is not short-} \\ \text{term debt}\end{pmatrix} \left[\begin{pmatrix}\text{Cost of} \\ \text{preferred} \\ \text{stock}\end{pmatrix} \begin{pmatrix}\text{% Preferred Stock} \\ \text{of long-term} \\ \text{capital structure}\end{pmatrix} + \begin{pmatrix}\text{Cost of} \\ \text{common} \\ \text{equity}\end{pmatrix} \begin{pmatrix}\text{% common equity} \\ \text{of long-term} \\ \text{capital structure}\end{pmatrix}\right]$$

A_c = Allowance for other funds used during construction.

---

*Weighted average determined under §35.13 of the Commission's Regulations Under the Federal Power Act.

FIGURE 16

(Continued)

Most electric utilities are subject either to the Federal Energy Regulatory Commission (FERC) or the National Association of Regulatory Utility Commissioners (NARUC) system of accounts, both of which are virtually identical. The treatment accorded AFUDC under the FERC and NARUC system can be noted: (1) prior to 1971-72, (2) 1973-1976, and (3) 1977-current. Table 24 shows a partial income statement for the three periods. There is a difference in classification during these periods, and while the net effect of the AFUDC credit is the same, confusion has arisen as to the effect of the classification on ratios.

Prior to 1971-1972, the "interest charged to construction" was a deduction from "other interest expense." The 1977 FPC Order Numbers 561 and 561A (18) (19) split the credit into two components, the "allowance for borrowed funds used during construction" (AFBFUDC) which is a reduction in other interest expense, and "allowance for other funds used during construction" (AFOFUDC) which is classified as "other income." The reclassification of the debt component caused confusion as to the treatment which it should be accorded for ratio calculations. FERC issued a clarifying order on 561 and 561A in January 1978 (15). The issue of whether "the allowance for borrowed funds used during construction" could be included in determining earnings available for fixed charges and preferred stock dividend requirements for charter and indenture coverage test was

TABLE 24

PARTIAL INCOME STATEMENT FOR ELECTRIC UTILITIES UNDER THE JURISDICTION OF THE FEDERAL ENERGY REGULATION COMMISSION SHOWING TREATMENT OF CONSTRUCTION FUNDS

		Prior 1971-1972	1973-1976	1977-Currently
	Net utility operating income	--	--	--
2.*	Other Income and Deductions			
	Other income:			
	Non-utility operating income			
	Interest and dividend income	--	--	--
	Allowance for funds used during construction		xxx	
419.1*	Allowance for other funds used during construction			000
	Total other income			
	Total income	--	--	--
	Miscellaneous income deductions	--	--	--
	Income before interest charges	--	--	--
3.*	Interest charges:			
	Interest on long-term debt	--	--	--
	Amortization of debt discount, premium, and expense	--	--	--
	Other interest expense	--	--	--
	Interest charged to construction -cr	(xxx)		
432*	Allowance for borrowed funds used during construction -cr			(bbb)
	Total interest charges	--	--	--
	Income before extraordinary charges	--	--	--

* Account number--Uniform System of Accounts.

clarified. The AFBFUDC could be used to the same extent as in the past. The purpose, according to FERC, of the repositioning was to better inform readers of the financial statements, not to influence or interpret the rights of parties under existing indenture agreements and corporate charters. The SEC issued Staff Accounting Bulletin No. 15 in August 1977, which requires that the interest component of AFUDC be credited directly to interest expense, which created a conformity between the FERC and SEC requirements.

Order 561 revised the Statement of Changes in Financial Position to provide that the equity component of AFUDC be treated as a noncash item in the "Sources of Funds" section and as an adjustment to construction expenditure in the "Application of Funds" section. The SEC Staff Accounting Bulletin No. 15 provided that, "on statements of changes in financial position at least the 'other' funds component of AFC credits should be excluded from funds provided from operation and from funds applied to construction and plant expenditures as provided in the amended FPC forms. The total amount of AFC credits may be excluded if deemed appropriate by the registrant." (42, 2) This continued a practice that the SEC had been requiring administratively for some time (38).

As mentioned in Chapter I, disclosure of CWIP accounting practices has been lacking. The class action suit quoted was brought in 1972, and is not yet resolved. However, the financial reporting disclosure is still lacking. Most utilities define AFUDC in the summary of accounting policies. These descriptions vary in basic approach. Some firms comment on the appropriateness of cost, while others emphasize the procedure. In the two examples which follow, only the second specifically notes that AFUDC is not a cash return. This disclosure, however, implies that the cash return will be realized. Neither disclosure attaches any uncertainty to the future realization:

> (Florida Power Corporation, 1976):
>
> This item represents the estimated cost of funds applicable to utility plant in process of construction.. Recognition of this item as a cost of utility plant is appropriate because it constitutes an actual cost of construction, and, under established regulatory rate practices, the company is permitted to earn a return on such costs and to recover them in the rates charged for utility services. (21, 17)
>
> (Illinois Power Company, 1977):
>
> The Federal Energy Regulatory Commission ('FERC') Uniform system of Accounts defines Allowance for Funds Used During Construction ('AFDC') as the net cost for the period of construction of borrowed funds used for construction purposes and a reasonable rate on other funds when so used. AFDC is capitalized at a rate which is related to the approximate overall cost of capital reduced by the income tax effect of the interest portion thereof. While cash is not realized currently from such allowance, it is realized under the ratemaking process over the service life of the related property through increased revenues resulting from higher rate base and higher depreciation expense. (38, 5)

Interest Tax Benefits

The tax saving which arise from the current deductibility of interest on construction funds is treated in one of three ways:

1. The savings is passed on to current rate payers (flow-through).
2. The savings is "normalized" and a deferred tax account is established. Income tax expense "above the line"[1] for rate purposes is the same as it would be in the absence of the construction program. AFUDC is capitalized for a "gross" rate.
3. A net-of-tax method is used. The amount of AFUDC capitalized is net of the tax effect and the AFUDC income is likewise net of the tax effect. This method is equivalent to the normalization method if the income tax effect is allocated "above the line" for rate purposes. (Income tax expense would be the same

---

[1] The expression "above the line" is used in the industry to denote that an item affects net operating income and thereby rates. "The line" refers to the income statement's operating income calculation. "Other income" and "interest charges" are "below the line" items, and while they affect net income they do not directly affect utility rates and return on rate base.

for rate purposes as it is with normalization.)

It should be stressed that the second method, capitalization of AFUDC at a gross rate and normalizing the deferred taxes is equivalent to the third method, capitalization of AFUDC at a net-of-tax rates, only if taxes are allocated "above the line" for rate purposes. Income taxes are considered an operating expense for rate purposes. They affect operating income and thereby return on the rate base. Income tax expense for rate purposes must be increased by the amount of the interest tax benefits for both methods to be equivalent. This can be seen by referring to Table 25 which shows the income statements employing the net method without tax allocation (Column 1), the net method with allocation (Column 2), and the gross method with normalization (Column 3).

When the net method is employed without allocation (Column 1), the income tax expense for rate purposes is $210,000 which is the same as the IRS taxes payable. The $40,000 interest tax benefit is subtracted from the gross AFUDC of $80,000 and the AFUDC income is also reduced for a like amount, resulting in an AFUDC income of $40,000 and capitalized AFUDC of $40,000. The return on the rate base is 8.8%.

When allocation is used with the net method (Column 2), income tax expense for rate purposes is $250,000, while the current IRS payable is $210,000. The $40,000 interest

Table 25 Effects of Different Treatments of Construction Interest Tax Benefits on Net Operating Income and Return on Rate Base.

Income Statement	Net Interest Charged to Construction (No Tax Allocation)	Net Interest Charged to Construction (Tax Allocation)	Cross Interest Charged to Construction with Normalization
End of Period Net Operating Revenues (other than income taxes)	(1)	(2)	(3)
Less Income Taxes	$650,000	$650,000	$650,000
IRS Taxes Payable	210,000	210,000	210,000
Const. Interest Tax Benefits	-0-	40,000	40,000
Net Operating Income	$440,000	$400,000	$400,000
Other Income and Deductions AFUDC-cr.	$ 40,000	$ 40,000	$ 80,000
Income tax allocated above the line	-0-	40,000	
Income before Interest Charges	$480,000	$480,000	$480,000
Less Interest Expense	230,000	230,000	230,000
Net Income	$250,000	$250,000	$250,000
Return on Rate Base	8.8%	8.0%	8.0%
Return on Common Equity	10.0%	10.0%	10.0%
Deferred Taxes from Construction			$ 40,000

Assumptions:

1. Rate Base: $5,000,000 (net plant in service)
2. CWIP $1,000,000; invested at beginning of period
3. CWIP financed entirely by 8% notes payable
4. AFUDC rate 8%
5. Allowed rate of return on rate base 8%
6. Income tax rate: 50%
7. Equities: Common Stock, $2,500,000; 6% Bonds, $2,500,000; 8% Notes Payable, $1,000,000.

tax benefit is "other income" (FPC 1973-1976 treatment) instead of operating income as it would be without allocation. The rate of return on the rate base is 8%. This method has kept the operating results separate from the construction activities.

When the gross method with normalization is used (Column 3), the CWIP amount is multiplied by the AFUDC rate and the entire amount is capitalized and recognized as AFUDC income. Income tax expense is the same as if there were no construction program ($250,000) and the $40,000 interest tax benefit is considered deferred taxes. The rate of return on the rate base is 8%, the same as the net method with allocation (Column 2).

Over the operating life of the constructed asset, the effects of the net-of-tax method with allocation and normalization at the gross rate will be the same. The deferred taxes under normalization will be subtracted from the rate base which will equalize the difference in asset value between the two methods. Depreciation expense will be less with the net method but their income tax expense (for rate purposes) will be higher than the gross method. The gross method will amortize the deferred tax account to reduce future income tax expense for rates.

To summarize, the distinction between the net-of-tax method with allocation and a gross rate with normalization is as follows:

1. The net method with allocation results in an AFUDC income credit of $40,000 and $40,000 cash "other income" from current revenues
2. The gross rate with normalization results in an AFUDC income credit of $80,000 and cash "deferred taxes" of $40,000.

Financial statement disclosure of the interest tax benefits due to construction debt is specific about procedure, but lacking in explanation of economic effects. It is necessary for the reader to be familiar with the industry lingo of "above" and "below the line," before the effects are evident. Price Waterhouse (38, 10) in their 1978 public utility industry survey reports that the disclosure takes one of four forms:

1. Used a "net of tax" AFUDC rate, and increased income taxes "above the line" by the amount of such tax reduction effect with an offsetting credit "below the line" in Other Income usually captioned "Income Taxes--Credit" (example--Pennsylvania Power and Light)
2. Same as 1, except offsetting credit "below the line" is included in "Allowance

for borrowed funds used during construction--credit" in the Interest Deduction section of the Income Statement (example--Arizona Public Service)

3. Used a gross (before income taxes) AFUDC rate and provided deferred taxes "above the line" for tax effect of current deduction of interest component (example--Iowa Electric Light and Power)
4. Used a "net of tax" AFUDC rate and provided for deferred income taxes by a charge to other income (example--Carolina Power and Light).

The fourth method capitalizes a net amount, and also establishes a deferred tax account. Over the operating life it would appear to double count the tax effect. The deferred taxes will be subtracted from the rate base (during the operating life) yet a net amount is already reflected as asset value. Both depreciation and income tax expense will be lowered in the future operating expenses.

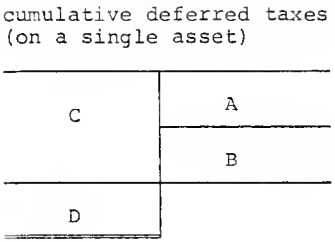
The Effects of Different Asset Valuation Bases on Cumulative Deferred Taxes

As a result of the AFUDC component being excluded for tax depreciation, two different valuation bases result for taxes and rate purposes. Consequently, the traditional treatment of deferred taxes must be adjusted. The APB Opinion No. 11 (2) prescribed that deferred taxes should be provided for all tax-timing differences and that differences in valuation bases (permanent differences) not be subject to interperiod tax allocation. However, regulated utilities are allowed exceptions to APB compliance under the addendum to Opinion No. 2 due to the effect of the rate-making process (1).

Some utilities are allowed to defer taxes during construction on the debt component of AFUDC and also normalize the difference in accelerated and straight-line depreciation when the plant goes on-line. Two different effects are present when a plant contains capitalized AFUDC, the tax-timing difference, and the different asset valuations for tax and rate purposes. The AFUDC is used for rate depreciation and excluded for tax depreciation. If only the tax-timing differences are present, the cumulative deferred taxes on an asset will have a zero balance at the end of its depreciable life. However, when a utility's asset has capitalized AFUDC, the difference in straight-line depreciation for rate purposes and straight-line depreciation without AFUDC must be considered or the cumulative deferred tax account will not result in a zero balance. Income tax expense (per rates) would never be great enough over the life of the asset to cover the IRS payable due to the difference in tax and rate bases.

Consider Figure 17, the "T" cumulative deferred taxes account. The ending balance (D) in this account will be a debit, amounting to the tax rate times the equity AFUDC if the traditional calculation of deferred taxes is used. Traditionally, income tax expense (per books and rates) would entail multiplying the reported net income by the statutory tax rate. The difference in the tax bill and the tax expense would then be the deferred tax debit or credit. With capitalized AFUDC, this calculation must be adjusted for the valuation differences or the account will never balance and rates will be underpriced.

Two Florida utilities were contacted regarding how they adjusted for this difference. One replied that they adjusted, but their accounting representative could not explain specifically the adjustment. The comptroller of the second firm replied that they did not adjust for this difference. A representative of the Florida Public Service Commission said that the common method was to adjust income tax expense for the difference in straight-line depreciation expense per rates and straight-line depreciation expense without AFUDC.



A = Beginning balance when asset goes on-line; taxes deferred during construction period (assume equal to t X debt AFUDC).

B = Credits during life of asset which result when taxes paid are less than tax expense on financial statements.

C = Total debits during life of asset which result when taxes paid are greater than tax expense on financial statements.

C - B = t X difference in valuation bases for tax and book purposes. For this example C - B = t X (debt + equity) AFUDC.

> 0 when IRS base $<$ book base

< 0 when IRS base $>$ book base

$= 0$ when IRS base $=$ book base.

FIGURE 17

THE EFFECTS OF DIFFERENT VALUATION BASES ON CUMULATIVE DEFERRED TAXES

Industry and Commission Surveys

A detailed, seven-page questionnaire was mailed the latter part of December, 1977, to 98 publicly-owned electric utilities who were members of the Edison Electric Institute, and a follow-up letter was sent to non-respondents in March, 1978. Sixty-six firms responded for a 67% response rate. The sizes and locations of the responding and non-responding firms can be seen in Appendix A along with the list of responding firms and the questionnaires.

Sixty-three firms were employed for most of the analysis. Some responses were incomplete due to the nature of the questionnaire. The majority (68.18%) of the respondents were class A utilities with revenues in excess of $100,000,000.

In order to get a different perspective on the theory questions and to ascertain if actual practices were consistent with stated policy, a questionnaire was sent to the accounting representatives of the fifty public service commissions in the latter part of April, 1978. Thirty-six[1] responses were received for a 72% response rate. The responding states are given in the Appendix along with a comparison of the respondents and non-respondents as to location.

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[1] Nevada was a late respondent and excluded from most analyses except where noted.

CWIP Accounting Practices

The majority of the firms (51%) capitalize AFUDC on their CWIP and have no rate base treatment of CWIP. (Table 26). Consequently, they do not receive a cash return on their current construction investment. They may, however, have a positive cash flow from the program if they are allowed normalized accounting or allocation for the interest tax benefits from construction funds.

Ten firms used the method of including CWIP in the rate base with offsetting AFUDC credits to revenue requirement exclusively, while eight other firms used this method in conjunction with other methods, for a total of 28.6%. As mentioned in Chapter III this method can result in a current cash return on CWIP depending upon (1) the differential between the AFUDC rate and the allowed return on the rate base, and (2) the manner in which prior AFUDC is compounded. All eighteen firms which use this methods had lower AFUDC rates than rate base rates. The distribution of the differences in rates can be seen in Table 27.

When all CWIP is included in the rate base with no off-setting AFUDC credits to revenue requirements the current return on CWIP is equal to that of plants in service. Only three firms (4.8%) responded that they used this method. In specific cases, commissions in Kentucky, Maine, Maryland, Texas, Virginia and Wisconsin have allowed this treatment.

TABLE 26

CWIP ACCOUNTING METHODS, SIXTY-THREE ELECTRIC UTILITIES, 1977

		Number of Firms	Percentage
1.	AFUDC capitalized with no CWIP in rate base	32	50.79
2.	CWIP in ratc base with off-setting AFUDC credits to revenue requirements.	10	15.87
3.	CWIP in rate base with no off-setting AFUDC credits to revenue requirements	3	4.76
4.	Combinations of two or more of the above methods	18*	28.57
		63	100%

*Eight firms use a combination of #1 and #2. Ten firms use a combination of #1 and #3. The combination results from different treatments being allowed for specific assets.

TABLE 27

THE DIFFERENCE IN AFUDC RATE AND THE ALLOWED RATE OF RETURN ON THE RATE BASE FOR EIGHTEEN FIRMS WHICH INCLUDE CWIP IN THE RATE BASE WITH OFFSETTING AFUDC CREDITS TO REVENUE REQUIREMENTS AND COMBINATIONS WITH THIS METHOD

% AFUDC Rate is less than rate base return	Number of Firms	Percentage
.01- .50	1	5.56
.51-1.00	5	27.78
1.01-1.50	2	11.11
1.51-2.00	3	16.67
2.01-2.50	4	22.22
2.51-3.00		
3.01-3.50	3	16.67
	18	100%

Question 1 of the commission survey inquired if the state had a law prohibiting the inclusion of CWIP in the rate base. Four states, Missouri, Montana, North Carolina, and North Dakota replied affirmatively. However, after July 1, 1979, North Carolina will require the inclusion of all CWIP in the rate base with no capitalization of AFUDC. Since receiving the questionnaire replies, referenda in Oregon and New Hampshire have passed which prohibit the inclusion of CWIP in the rate base. A measure to add the cost of CWIP funds as a surcharge to consumer's bill is before the New Hampshire legislature.

Eighteen firms responded that they used combinations of three methods described earlier. The most frequently mentioned combination (10 firms) was that of capitalizing AFUDC on some construction projects or dollar amounts (Method 1) and including CWIP in the rate base for others (Method 3). Table 28 shows the percentage of CWIP included in the rate base for these 10 firms. The next section discusses various methods used to determine amounts to include in the rate base.

Methods Used to Determine Amount of CWIP to Include in Rate Base

Explanatory notes on both the utilities' and commissions' questionnaires provide insight into the diverse methods used to determine the amount of CWIP to include in

TABLE 28

PERCENTAGE OF CWIP IN THE RATE BASE FOR TEN FIRMS WHICH USE METHOD 1 IN COMBINATION WITH METHOD 3

% CWIP in Rate Base	Number of Firms	Percentage
60-99		
50-59	1	10
40-49	2	20
30-39		
20-29		
10-19	5	50
0- 9	2	20
	10	100%

the rate base. Some states employ several methods, while many responded they had no formula or systematic approach to the problem.

Evaluation of financial integrity. In regard to a general approach to the problem of rate base allocation, the Texas Commission gave the following outline which describes their guidelines for "financial integrity," which is considered the motivation for inclusion.

> The Public Utility Regulatory Act of 1975 states in Section 41(a) in part ". . . Utility rates shall be based upon the adjusted value property used by and useful to the public utility in providing service including where necessary to the financial integrity of the utility construction work in progress at cost . . ." The phrase "necessary to the financial integrity" is the guideline to the methodology used by Commission staff in determining the amount of CWIP to include in rate base. The primary indicators used by the Staff are interest coverage, AFUDC as a percent of earning available for common stock, and percent of internal cash generation. These are determined on an individual company basis. The following outline is used in evaluating a company's financial integrity.
>
> 1. General Considerations
>
>   a. The Company should be able to meet all of its contractual obligations (to short-term creditors as well as bondholders-and preferred stockholders).
>
>   b. The Company should be in a position to attract additional capital (both short-term and senior debt as well as preferred and common equity) at virtually any point in time without fear of interest coverage deterioration or equity dilution.
>
>   c. The Company should not be forced to overextend its use of short-term credit (evaluated in light of its construction program and long-term financing objectives).

   d. The Company should generate a reasonable portion of its cash needs from internal sources; the precise percentage being a function of its construction budget and unique circumstances.

2. Debt Considerations

   a. The Company's bond ratings should not be in imminent jeopardy of being downgraded by rating agencies.

   b. The Company should have adequate pre- and post-tax coverage ratios (excluding AFUDC) on a prospective basis.

3. Equity Considerations

   a. The Company's common stock should sell at a price greater than its book value.

   b. The quality of the Company's earnings should be such that AFUDC does not comprise a large portion of net income available for common equity.

   c. The Company should have the ability to pay common stock dividends as expected by investors from current earnings rather than from additional or recovered capital investment (i.e., depreciation).

   d. The Company should have adequate cash flows from earnings for retention and reinvestment for growth.

A Florida utility provided a list of factors which they consider relevant to the question of the amount of CWIP to include in the rate base (Appendix). In addition to the financial integrity indicators given by the Texas Commission, they also included items which were a function of current socio-political commitments such as: conversion equipment from oil to coal, environmental requirement expenditures and construction designed to lower dependence on scarce fuels (such as coal and nuclear) to meet the nation's energy goals. They also included items aimed at upgrading the technology currently employed.

Two respondents mentioned that the timing of the rate base inclusion should coincide with the final stage of the construction cycle. The number of years prior to the in-service date that CWIP should be permitted in the rate base, they felt, should approximate that last portion of the construction cycle during which the utility has virtually no option but to complete the new facilities as planned, since the cost to the customer and company to delay would exceed the benefits to be realized.

Ohio law is fashioned after this philosophy. Construction which is 75% complete may, at the discretion of the Public Utility Commission of Ohio, be included in the rate base, but the amount may not excced 20% of the net plant-in-service.

Ultimate consumer as a basis for allocation (Intergenerational Equity). One of the conventional wisdoms of utility pricing is to let the consumer who benefits pay the cost. Since it is frequently contended that construction will benefit mainly future customers, the intergenerational equity argument is given as justification for AFUDC capitalization. A possible methodology for the amount of CWIP to be included in the rate base under this philosophy would be to:

1. Estimate amount of CWIP required for the benefit of a static number of customers.

2. The remainder of CWIP is considered for the benefit of net new customers.

3. Include 1 in the rate base, and capitalize AFUDC on 2.

In an attempt to determine if this were a feasible approach, the questionnaire asked utilities for the breakdown on the percentage of construction which would benefit new customers and the majority (83%) could not supply this information. The allocation would be a function of the expected growth of the particular area and vary widely. Of the eleven respondents who could allocate, this was confirmed. Southern California and coastal New Jersey estimated the percentage to benefit new customers to be in the mid to high 80's for 1978-1982, while parts of Michigan and Virginia estimated in the low 10's.

A Florida respondent felt that methodology is difficult, if not impossible, because

> The breakdown of expenditures between new and existing customers cannot be calculated, because of the difficulty in determining the reasons for increased load, the difficulty of quantifying the benefits of improved system reliability and system efficiency, and the difficulty in allocating the benefits of a better environment, less dependence on imported oil, savings due to nuclear fuel. There are also the economics of an inter-connected system that uses an economic dispatch system. When more efficient base load plants are placed in service, the existing less efficient base load plants can be used as mid-range or peaking units. Thus all customers benefit, especially in the case of the fuel savings from a nuclear plant. Also, all customers benefit from improved system reliability resulting from better reserve margins, transmission grids, modern distribution systems. Therefore, it is virtually impossible to say that a specific expenditure is for a new customer or an existing customer.

The industrial respondents, in general, thought the approach of ultimate consumer as an allocation basis was not feasible for various reasons. One respondent classified it as "ivory tower" thinking

> Some of your questions indicated that the ultimate customer to use the facilities under construction should have a bearing as to how much CWIP would be included in the rate base. I frankly think this is "ivory tower" thinking. . . . I do not believe that an electric utility should attempt to segregate plants as being "plant-in-service" or "CWIP." In my view, plant under construction is as much a part of the utility's business as is that plant which has been in-service for many years. Both are needed if we are to continue to service all of our customers.

A frequent justification for rate base inclusion of CWIP, which is not inconsistent with the ultimate consumer philosophy, is that the present consumer can benefit from the CWIP in the rate base due to a variety of reasons. For example, the Public Service Commission of Nevada in Docket No. 959 is of the opinion that

> The inclusion of CWIP in rate base necessarily involves a judgement that it is equitable for present ratepayers to provide funds that, under present Commission policy, would be provided by future ratepayers. In considering the evidence of of the record regarding the dollar savings over the service life of the generating plants, intangible benefits of a higher quality of earnings, together with benefits of using coal as an energy source, the Commission is of the opinion that in limited circumstances including CWIP in rate base is a benefit to the present customer. . . .

General approaches used by selected states. The majority of the Commissions said they lacked a rule of thumb to determine the amount of CWIP to include in the rate base. A case by case approach was the most common. Several methods which have been used in the past, can be seen in Table 29.

Interest Tax Benefits Practices

The tax savings that arise from the current deductibility of interest for income tax purposes may be flowed through to current ratepayers, normalized, or allocated as discussed earlier. In theory, these savings should accrue to the customers who pay the interest. Therefore, firms which capitalize AFUDC at a gross rate should normalize the tax benefits and firms which have rate base treatment should flow through the benefits. This would be the theoretically consistent treatment since present customers would not benefit at the expense of future customers. For firms which use combination methods, the tax benefits should be allocated proportionally, based on the amount of CWIP in the rate base.

Table 30 shows that some form of allocation of the benefits is the prevelent practice: 44.4% normalize, 12.7% use a net-of-tax method, and 4.8% use a combination. However, flow-through is used to a greater extent than theory would substantiate. Table 31 shows a further breakdown of the responding firms according to CWIP accounting method as well as interest tax benefits from construction. Ten firms in the first group which capitalize AFUDC (Method 1) flow

TABLE 29

METHODS USED TO DETERMINE AMOUNT OF CWIP IN THE RATE BASE

Alabama:	The statutory rate base includes not only test year CWIP, but also the new investment to be added during the next 12 months. The offset to revenue requirements is for the test year AFUDC only.
California:	Projects under $5,000 and *operative* CWIP are allowed in the rate base. Operative CWIP is that amount which has not yet been cleared to primary accounts but has become operative.
District of Columbia:	A thirteen month average.
Florida:	Past hearings have considered (13) 1) averages of 3, 4, and 5 year CWIP closed to plant-in-service. 2) average amounts of CWIP outstanding for varying lengths of time. (Test year plus previous years.) 3) The ratio of equity supported construction. 4) The percentage of CWIP to total capital.
Georgia:	CWIP allocated to *retail* service base on a *prospective* average rate base. The retail percentage was determined from the most recent test year using a coincident peak method. This percentage was used on a prospective rate base for the beginning of the succeeding year. (Docket No. 2663-U).
New York:	The size of construction project determines if it is classified as "non-interest bearing" in which case it can be included in the rate base. Interest bearing projects are those which would

TABLE 29

(Continued)

New York (continued)	generate a minimum of \$50,000 AFUDC annually. Long Island Lighting was allowed to determine the rate base amount of CWIP based on the percentage of income represented by AFUDC. The target of 27% AFUDC/income was set in a recent case.
Ohio:	Ohio law permits inclusion of CWIP in the rate base which is 75% complete as determined by the Commission after inspection. The amount included cannot exceed 20% of the rate base value exclusive of the CWIP.
Washington:	The percentage allowed in the rate base is calculated by the following formula: (13) The difference between the allowed rate of return on total permanent capitalization (k_a) and the AFUDC rate (k_{AF}) expressed as a percent of the allowed rate of return on total permanent capitalization; i.e., $\frac{k_a - k_{AF}}{k_a}$ = % allowed in rate base For example, this results in 25.7% if the following rates are assumed. $\frac{9.69 - 7.2\%}{9.69\%} = 25.7$ $9.69 = k_a$ $7.2 = k_{AF}$

TABLE 29

(Continued)

Wisconsin:	The PSC of Wisconsin does not allow CWIP in the rate base per se, but adjusts the required return on the rate base to provide a return on CWIP. This is done in the following manner:

$$\frac{\text{CWIP}}{\text{Rate Base}} \times k_a - \frac{\text{CWIP} > 10\% \text{ Rate Base}}{\text{Rate Base}} \times k_{AF}$$

+ Rate of Return on Rate Base = Adjusted Rate of Return on Rate Base.
k_a = rate of return on rate base
k_{AF} = AFUDC rates

The portion of CWIP which does not exceed 10% of the average net investment rate base in a calendar year receives the allowed rate of return of rate base in current revenues. Any excess of 10% receives AFUDC and is deducted from the revenue requirements for the adjusted rate of return on the rate base.

TABLE 30

TREATMENT OF INTEREST TAX BENEFITS DUE TO CONSTRUCTION WORK IN PROGRESS OF SIXTY-THREE ELECTRIC UTILITIES, 1977

	Number of Firms	Percent
Normalize	28	44.44
Flow through	24	38.10
Net-of-tax	8	12.70
Combination	3	4.76
	63	100%

TABLE 31

TREATMENT OF INTEREST TAX BENEFITS DUE TO CWIP BY SIXTY-THREE ELECTRIC UTILITIES CLASSIFIED ACCORDING TO CWIP ACCOUNTING METHOD, 1977

Interest Tax Benefits Treatment	Number of Firms	Percent
Accounting Method 1--AFUDC capitalized, no CWIP in rate base.		
Normalize	14	43.75
Flow-through	10	31.25
Net-of-tax	6	18.75
Combination	2	6.25
	32	100%
Accounting Method 2--CWIP in rate base with offsetting AFUDC credit.		
Normalize	3	30
Flow-through	6	60
Net-of-tax	1	10
	10	100%
Accounting Method 3--CWIP in rate base.		
Flow-through	3	100
	3	100%
Combination of above methods.		
Normalize	11	61.11
Flow-through	5	27.77
Net-of-tax	1	5.56
Combination	1	5.56
	18	100%

through the interest tax benefits. This practice clearly benefits current customers at the expense of future ratepayers. Upon closer analysis of these firms and their commissions's position on normalization some explanations were evident.

1. One firm is trying to normalize the construction tax benefits pending the approval of their commission. The commission's reply to the question regarding normalization of these benefits was that they had no stated position.
2. Two firms were in states where the commission's stated policy was to consider the question on a case by case basis.
3. Two firms were in states where their commission's stated policy was to permit only flow-through treatment.
4. Three firms were in states where their commission's stated policy was to permit normalization; yet they flow through the benefits. No explanations were given.

For firms which employ Method 2, which results in the cost of funds being split between current and future ratepayers, it appears that the interest tax benefits are largely (60%) flowed through to current customers.

A "net-of-tax" method is used by eight of the respondents. They all noted that this method is equivalent to normalization with the gross method. However, as discussed earlier, this is true only if the tax effect is allocated "above the line." Only four respondents specifically noted that they allocated.

Regarding regulatory treatment of the interest tax benefits from construction, flowing through the tax benefits to present customers in states which prohibit rate base treatment of CWIP would clearly seem to be inconsistent. Of the states with legal prohibition against CWIP in the rate base, Missouri is the only commission which requires flow-through treatment of the interest tax benefit due to the construction program.

Compounding of AFUDC

Fifty-one percent of the responding firms earn a return on the previously accumulated AFUDC. Prior to the FPC's Order Number 561 which became effective in 1977, commissions generally did not allow compounding on AFUDC. Order Number 561 permits compounding on a semi-annual basis for jurisdictional assets and was frequently mentioned as the impetus for this treatment.

If one dollar of capitalized AFUDC is to be as valuable in terms of future returns as the investment of one dollar of cash in CWIP, it must have a return in the succeeding years of the construction program. The form of the compounding increment in the remaining years of the construction program is a function of the method employed.

If method 1 of capitalizing AFUDC with no CWIP in the rate base is used, current revenue requirements are not affected by the current construction program and if AFUDC is compounded, AFUDC credits will be received for prior AFUDC. The cash flows in the future are expected to be greater since the AFUDC capitalized will be greater.

Nineteen percent of the respondents who use this method do not compound (Table 32).

If the method of including CWIP in the rate base with a subtraction of AFUDC for current revenue requirements is used, current cash flows can be affected depending upon (1) the differential between AFUDC rate and the allowed return on the rate base, and (2) whether the CWIP balance for the rate base includes prior AFUDC and whether the CWIP balance for AFUDC calculation also includes prior AFUDC. Referring to Table 32, it can be seen that fifteen respondents (out of eighteen who use this method) claimed not to compound AFUDC on prior AFUDC (Question 2). It is not known if they actually earn compound interest on prior AFUDC, however. At the time of the questionnaire, the implications of this method were not realized and the compounding question was not explicit as to which CWIP balance was being compounded. The literature, until this research, had not developed the ramifications of this method. Prior research was done almost exclusively by Johnson (27) who defined "compounding" narrowly:

> Compounding refers to whether AFUDC is computed by applying the AFUDC rate to the CWIP base, excluding previously capitalized AFUDC (not compounding), or to the entire CWIP base (compounding). (27, 21)

This definition fails to consider that the overall return received when using this method is a function of the rate of return on the rate base, and that the CWIP in the rate base is the relevant balance for determining

TABLE 32

NUMBER OF FIRMS WHICH DO NOT COMPOUND PRIOR AFUDC

Classified by Accounting Method[1]		Percentage of Respondents
Method 1--The capitalization of AFUDC. CWIP not in rate base.	12 firms	19%
Method 2--CWIP in the rate base with offsetting AFUDC credits to revenue requirements.[2]	15 firms	24%
Combinations of Methods 1 and 2.	4 firms	6%
		49%

---

[1] Response to industry questionnaire Question 2. See Appendix.

[2] As discussed in the text, some of these firms may be compounding prior AFUDC, but interpreted the question to apply to AFUDC credits only.

compounding. The AFUDC for current revenue requirement reduction affects only the form of the return. A more accurate definition of compounding when this method is employed is as follows:

> Compounding refers to whether a return is earned on prior AFUDC, regardless of whether the return is a current cash return or AFUDC credits. If prior AFUDC is included in the rate base CWIP, the method is compounding. If prior AFUDC is excluded, the method is not compounding. The current AFUDC calculation for revenue requirements determines the form of the return if compounding is allowed, but alone, does not determine if compounding is occurring.

It is difficult to believe that 83% of the respondents who use this method suffer a loss on investment by not receiving a return on prior AFUDC. It is more likely that their response meant that they did not compound AFUDC on AFUDC and they receive the compound increment as a current cash revenue, not AFUDC credits. In other words, the CWIP balance for rate base purposes included prior AFUDC, but the current AFUDC calculation for revenue requirement reduction did not include prior AFUDC in the CWIP balance.

Table 33 shows the Public Service Commissions which do not permit compounding of prior AFUDC in conjunction with the accounting methods permitted. The states in the first category which employ Method 1 would appear to treat AFUDC as in inferior asset since it is not allowed a return during the remainder of the construction period. The states in the second category may or may not actually compound AFUDC. As mentioned earlier, their interpretation of the question and of "compounding" is not known.

TABLE 33

STATE COMMISSIONS WHICH DO NOT PERMIT COMPOUNDING OF PRIOR AFUDC, CLASSIFIED ACCORDING TO ALLOWED ACCOUNTING METHOD

Thirty-Five Responding Public Service Commissions, 1978[1]

I Method 1--The capitalization of AFUDC. CWIP not allowed in rate base.

Hawaii
Idaho
Massachusetts
New Jersey[2]
New Mexico
Oklahoma
Washington
West Virginia
Nevada

II Method 2--CWIP in the rate base with offsetting AFUDC credits to revenue requirements.

Delaware
Michigan
Minnesota
New Jersey[2]
Virginia

---

[1] Response to commission questionnaire. Question 3. Does your Commission allow compounding on the AFUDC component of CWIP?

[2] State permits more than one method of CWIP treatment.

Effects of AFUDC Earnings on the Ability to Finance

Most utilities' bond indentures require a minimum pro forma times interest earned ratio before new debt may be issued. The nature of the income to be included in the coverage calculation is also frequently restricted. A common prohibition is on the total amount of "Other Income" that can be included in adjusted income for the calculation of coverage. AFUDC income is classified as "Other Income" and is thereby restricted in this manner. In addition, a specific restriction on the amount of AFUDC income to be included for coverage purposes is common in the industry. Eighty-four percent (54 firms) report that their bond indentures restrict the amount of AFUDC which can be included. Usually it cannot exceed 15% of adjusted income. Respondents describe the limitations as follows:

> First mortgage bond indentures exclude all AFUDC and depreciation, so the amount of AFUDC does not impact coverage under this indenture. The company's debenture indenture is the restrictive one that limits the company's ability to issue all debt.
>
> Indenture allows the company to use "other income" up to 15% of the net earnings as defined by the indenture. Included in "other income" is the equity portion of AFUDC. By letter, the trustees confirmed the use of AFUDC as a portion of net earnings which is eligible for use in coverage calcuation. Until the split of AFUDC into "debt portion" and "equity portion," the company used all of the AFUDC in the coverage calculation. Now it uses only the equity portion.
>
> Limited non-operating income and no AFUDC is allowed in coverage calculation. Coverage limitation has been approached resulting in the issuance of junior securities.

Several firms expressed concern that the FPC Order Number 561, which requires the borrowed funds component of AFUDC to be moved from "Other Income" to a reduction of interest expense, would reduce their coverage. However, FERC's clarifying order issued in January, 1978, states that it was not the purpose or intent of Order No. 561 to affect the firm's coverage rates for indenture purposes and that "the allowance for borrowed funds used during construction" could be included in determining earnings available for fixed charges and preferred stock dividend requirements to the same extent as formerly allowed.

There are two types of financing limitations which can be caused by AFUDC being a large percentage of net income; tangible and intangible. The tangible limitation exist with the coverage requirement, which can make debt financing impossible, and an intangible limitation can be caused by the quality of earnings which results in the investor's rejection of security offerings. While the tangible limitation has been noted in rate hearings and trade magazines, prior to this survey, the extent of it was not known.

In reply to question #6 which asked if the indenture provision had ever actually prevented the utility from financing, fourteen respondents (22%) replied affirmatively. Comments describing this situation were:

> In 1974, the company's coverage actually fell below the 2X interest level, thereby precluding further sale of bonds. The amount of AFUDC excluded was

> around $30,000,000 which would have allowed the Company to sell additional bonds ($125,000,000 at 12%) in September and October. By November coverages had deteriorated even beyond the $30,000,000 level.

> No AFUDC can be included in our coverage calculations. In 1971 and 1973, large amounts of AFUDC lowered the quality of earnings to the point where we could not issue bonds.

> We can use no AFUDC and other nonoperating income in the calculation. This provision prevented us from issuing bonds one time in the past.

Of the fourteen respondents who could not finance, five of them (36%) were capitalizing AFUDC on all of their CWIP (Method 1) and were not allowed rate base treatment of CWIP. It is not known if these fourteen companies were realizing their allowed rate of return at this time; however, their mean average value of CWIP/total assets was larger than the other respondents. (For the period 1972-1976, their average was 19.1% as compared to 15.9% for the others.) Fifty-seven percent (8 firms) were involved in nuclear construction during this period.

This result points up the fact that if a certain combination of events occurs such as a large CWIP/asset ratio, a long construction program and possibly attrition, the AFUDC restriction clause will have a cost, even if it cannot be specifically quantified.

While the indenture restrictions have prevented some firms from financing with debt or preferred stock, others which have no restrictions on the AFUDC inclusion for coverage purposes, may have been enabled to finance due to AFUDC. However, bond rating agencies are sensitive to the nature and effect on coverage. Moody's Bond Survey, which analyzes and rates new bond issues comments on the quality of the reported earnings, particularly when AFUDC is a large fraction of earnings.

Projected Importance of CWIP Accounting

The importance of the accounting for CWIP depends upon the size and nature of the construction program. The ratio of CWIP to total assets and the length of the construction period are important factors if AFUDC is capitalized. The fluctuations in earnings, external financing and cash flows are accentuated by a high CWIP/total asset ratio and long construction programs. For the responding firms, it can be seen in Table 34 that the CWIP to total asset ratio is projected to rise from an average in 1972-76 of 16.69% to 23.92% by 1987.

Responding utilities show a projected increase in the percentage of their construction budget which will be allocated to nuclear generation, which has an estimated minimum lead time of eight years. Current political developments involving oil supplying nations since the questionnaire survey probably will alter the nature of planned facilities to some extent. Construction periods would be shorter for coal generation plants; however, a high rate of inflation could create the sharp fluctuations associated with the longer programs. The CWIP accounting promises to be a continuing problem.

TABLE 34

CWIP AS A PERCENTAGE OF TOTAL ASSETS

1972-1976	1977	1978-1982	1983-1987	
16.69	17.86	21.48	23.92	: Mean Value
8.66	10.72			: Standard Deviation
45	56	47	29	: Number of Companies

Comparison of Utilities Practices and Regulatory Policy

The CWIP accounting methods and AFUDC practices used by the responding utilities were compared with the stated policy of their commission (Table 35). As to be expected, there was 100% agreement of their accounting CWIP method, however the AFUDC treatment in some cases is not in agreement. Four firms do not compound AFUDC, while their commission's stated policy is to allow it. Three of these firms use the method of including CWIP in the rate base with an offsetting AFUDC credit to revenue requirements. These firms probably do not compound AFUDC for current revenue requirements, but do get a current cash return on prior AFUDC, as mentioned earlier. Since FERC allows semi-annual compounding for their jurisdictional assets, it might be expected that some utilities compound in states where the commission doesn't permit it. This did occur for one state, Minnesota.

There was a lack of agreement in the handling of the interest tax benefits of construction in two cases. Delaware permits normalization yet a Delaware respondent flowed through the benefits.

Another case appears to be in Oklahoma where the commission's stated policy is flow through, yet the responding firm normalizes.

TABLE 35

REGULATORY POLICY VS UTILITIES' PRACTICE

Responding State Commissions	CWIP Accounting Method*	Normalization of Construction Income Tax Benefits	Compounding of AFUDC	Number of Responding Utilities	CWIP Accounting Methods	Normalization of Construction Income Tax Benefits	Compounding of AFUDC
Alaska	1,2	**	**	0	---	---	---
California	1	yes	yes	3	1	****	yes
Colorado	2	**	yes	2	2	no	no^{+}
Connecticut	1	no	yes	2	1	no	no^{+}
Delaware	2	yes	no	1	2	no^{+}	no
District of Columbia	3	yes	no	1	3	yes	no
Florida	1,3	yes	**	3	1,3	yes	no
Georgia	2	no	**	1	2	no	no
Hawaii	1	yes	no	0	---	---	---
Idaho	1	**	no	1	1	yes	no
Illinois	1,3	yes	yes	3	1,3	****	yes

(Continued)

TABLE 35

CONTINUED

Responding State Commissions	CWIP Accounting Method*	Normalization of Construction Income Tax Benefits	Compounding of AFUDC	Number of Responding Utilities	CWIP Acccunting Methods	Normalization of Construction Income Tax Benefits	Compounding of AFUDC
Indiana	1,3	--	--	1	1	yes	yes
Louisiana	2	no	yes	1	1	---	---
Maine	2	no	yes	0	---	---	---
Massachusetts	1	yes	no	3	1	yes	yes
Michigan	2,3	no	no	1	2	no	no
Minnesota	2	yes	no	2	2	yes	no/yes^{+}
Missouri	1	**	yes	2	1	yes	no^{+}/yes
Montana	1	yes	yes	0			
Nebraska	All Utilities are Public-Owned & Not Regulated						
New Hampshire	1	yes	yes	0			
New Jersey	1,2,3,	no	no	2	2	no	no
New Mexico	**	**	no	0			

(Continued)

TABLE 35

CONTINUED

Responding State Commissions	CWIP Accounting Method*	Normalization of Construction Income Tax Benefits	Compounding of AFUDC	Number of Responding Utilities	CWIP Accounting Methods	Normalization of Construction Income Tax Benefits	Compounding of AFUDC
North Carolina	1	yes	yes	1	1	yes	yes
North Dakota	1	yes	yes				
Oklahoma	1	no	no	1	1	yes$^+$	no
Oregon	1,2	**	yes	1	2	yes	no$^+$
South Carolina	1	yes	yes	0	---	---	---
South Dakota	1	no	yes	0	---	---	---
Tennessee	2	no	yes	0	---	---	---
Texas	1,3	**	**	4	1,2,3	1 yes, 3 no	no
Virginia	2	**	no	0	---	---	---
Washington	1	no	no	1	---	---	---
West Virginia	1,3	no	no	0	---	---	---

(Continued)

TABLE 35

CONTINUED

Responding State Commissions	CWIP Accounting Method*	Normalization of Construction Income Tax Benefits	Compounding of AFUDC	Number of Responding Utilities	CWIP Accounting Methods	Normalization of Construction Income Tax Benefits	Compounding of AFUDC
Wyoming	1,2	yes	yes	0	---	---	---

*CWIP Accounting Methods:
1 = AFUDC capitalized on CWIP.
2 = CWIP in the rate base with an offsetting AFUDC credit to revenue requirements.
3 = CWIP in the rate base.

**No stated policy or case by case treatment.

[+] Not consistent with commission's stated policy.

Comparison of Utilities' and Commissions' Opinions on AFUDC Theory

A response comparison was made between utilities' and commissions' opinions as to the theoretically consistent method to handle the interest tax benefits, compounding AFUDC, and determination of an AFUDC rate (Table 36). Nine commissions (27%) opposed the normalization of the interest tax benefits and seven (26%) opposed compounding AFUDC. While one would expect, in theory, for these practices to be consistent with AFUDC capitalization, their effects on current and future rates could account for the commissions' opinions. Several responses from the utilities on these issued are difficult to explain. Two utilities (3%) opposed normalization of the interest tax benefits and six (9%) opposed compounding AFUDC. (As was noted earlier, the definition of compounding may account for this last group.)

Most firms thought the AFUDC rate should be (1) marginal cost of capital (39%), (2) the weighted average cost of capital (25%) or (3) FERC formula rate (22%), while commissions favored the FERC formula rate (41%) or the weighted average cost of capital (32%). The big difference of opinion between the utilities and the commissions was on the marginal cost rate. The Florida commission has pointed out (_Florida Power and Light_, Docket No. 74509-EU) that the use of current cost of capital for AFUDC would result in double counting if the allowed rate on the rate

TABLE 36

COMPARISON OF UTILITIES' AND COMMISSIONS' OPINIONS ON AFUDC THEORY. SIXTY-FOUR ELECTRIC UTILITIES AND THIRTY-FOUR PUBLIC SERVICE COMMISSIONS, 1978

	Utilities	%	Commissions	%
Treatment of Construction Program interest tax benefits:				
Normalize	52	81	15	44
Flow through	2	3	10	29
No opinion	10	16	9	27
	64	100%	34	100%
Compounding of Prior AFUDC:				
Yes	47	73	18	53
No	7	11	9	26
No opinion or no reply	10	16	7	21
	64	100%	34	100%
AFUDC rate should be:				
Weighted average cost of capital*	16	25	11	32
Below the weighted average cost of capital	2	3	4	12
Above the weighted average cost of capital	2	3		
Marginal cost	25	39	1	3
FPC Formula	14	22	14	41
No opinion or no reply	5	8	4	12
	64	100%	34	100%

base is a weighted average. The utility respondent's answers may have assumed a different theoretical treatment of the allowed rate on the rate base.

Summary

The questionnaire surveys have shown:

(1) The capitalization of AFUDC, the predominate practice, has frequently not been treated consistently by firms and/or commissions regarding interest tax benefits and compounding.

(2) Forty-nine percent of the utilities have some CWIP in the rate base, but there is no general rule of thumb used to determine the amount. A case by case analysis of the financial integrity of the firm appears to be the general rule.

(3) An allocation scheme to include CWIP in the rate base which benefits old customers and capitalize AFUDC on CWIP which will benefit net new customers is not considered feasible due to the nature of the industry's technology and measurement problems.

(4) Empirical evidence was obtained that AFUDC has prevented financing in the past.

CHAPTER VII

SUMMARY AND CONCLUSION

The rate making process of regulated industries makes accounting for them substantially different from unregulated firms. The accounting process itself has economic implications due to its effect on rates and capital costs. If CWIP is included in the rate base, the current construction financing costs are realized in cash, but the intergenerational equity question is raised. It is not a politically popular move since rates are initially increased. The alternative of capitalizing AFUDC can result in affecting the cost of capital. When AFUDC is capitalized, the uncertainty of the regulatory process can attach to this income since it may never be realized in cash. This research has shown that firms which capitalize AFUDC can be riskier because:

(1) operating incomes and cash flows fluctuate sharply over the construction cycle. This increases a firm's susceptibility to business risk.

(2) financial risk is greater due to effects on coverage ratios, constraints caused by indenture clauses, and more frequent financing.

(3) regulatory risk is greater since the cash realization of AFUDC depends upon prompt and sufficient rate relief over the entire life of the constructed plant.

Security market research substantiated this higher risk. Multiple regression analysis has shown that AFUDC had a significant effect on the cost of capital in the seventies. Evidence seems to point to a threshold effect. One model, which divided the sample into two groups, firms with ≤ 15% AFUDC/NI and firms with > 15% AFUDC/NI, demonstrated that the cost of capital was less for the group with ≤ 15% for 1974, 1976 and 1977. Another model showed that the AFUDC coefficient changed signs between 15% - 20% AFUDC/NI but did not have a significant negative effect on P/B ratio until 20-25%. A third model, showed the AFUDC coefficient had a negative effect on P/B at a sample average of 17% and 22%, but was not significant until the average rose to 25%.

A solution which is frequently allowed by commissions (49% of questionnaire respondents) is to allow some CWIP in the rate base along with capitalization of AFUDC. The important question is how to determine the amount to allow in the rate base. An ideal solution would be to capitalize AFUDC until the cost of capital is affected, then allowed rate base treatment. If a threshold does exist at around 15-20% AFUDC/NI, this could be a useful generalization.

A commonly used method to alleviate some of the cash flow implications of AFUDC capitalization is to include CWIP in the rate base with AFUDC subtracted from revenue requirements. This method was modeled for the first time in the literature. The cash return, the AFUDC return and the total return were derived. The compounding of prior AFUDC for this method with its cash implications is also developed.

The computer simulation of the two CWIP accounting methods gave a 25 year projection of the effects of a firm which switches from capitalizing AFUDC to including CWIP in the rate base. The largest contrast between this firm and a capitalizing firm occurs in the last year of the first construction cycle. The simulation employed conservative assumptions about costs and demand. Even with these assumptions and a deterministic model, it was not possible for the capitalizing firm to generate an average 40% of their funds internally which is the industry's projected target.

Questionnaire results show that the predominate practice is to capitalized AFUDC with no CWIP in the rate base. However, almost 50% of the firms do have some CWIP allowed in their rate base. There does not appear to be any rule of thumb to determine the amount to include. The general practice has been to decide using a case by case approach considering the financial integrity of the utility. Regarding the effects on financinal risk, the questionnaire has supplied empirical evidence that the capitalization of AFUDC has prevented fourteen firms from financing in the past. The questionnaire results also point to the fact that interest tax benefits from construction programs and compounding of prior AFUDC are frequently not treated consistently.

The practice of capitalizing AFUDC as the only form of return on CWIP funds can increase an electric utility's risk. The method is inherently subject to business, financial and regulatory risk to a degree which the cost of capital itself is increased if AFUDC is a large percentage of earnings.

More empirical evidence is needed before a threshold level of AFUDC/NI can be established; however up to 15% AFUDC/NI, the market does not appear to discount AFUDC.

APPENDIX CHAPTER IV

Computer Simulation, Lead-in-Period and Investment Strategy

The performance of the simulated system does not become representative of the corresponding real world system until it has reached a steady-state condition because of the artificiality introduced by the abrupt beginning of operations. A steady-state condition implies that the state of the system has become independent of the initial state and the elapsed time since the start-up. Consequently, a lead-in period is required. The starting conditions for this model could be considered typical of many utilities. It assumes a firm began operations ninety-six years ago with one generating plant purchased on a turn-key basis. Ninety-six years after commencing operations the company has a vintage of generating plants. Typical of most utilities, the model company has been capitalizing an allowance for funds used during construction (AFUDC) during its lifetime and normalizing income tax benefits due to accelerated depreciation and construction interest. Assumptions concerning the lead-in-period investment strategy are as follows:

(1) The utility purchases a plant at the beginning of year 1 on a turn-key basis. This plant has the capacity to generate 100 kilowatts which is a

10 percent excess of the estimated demand at the beginning of year six. All plants are assumed to have a 30 year lifetime.

(2) A new plant goes "on-line" every 5 years. The company begins construction on plant number 2 at the beginning of year 1. Each construction period is five years. The capacity of each new plant is such that five years after its completion the combination of plants will be able to generate 10 percent above the estimated demand at that time. Figure 1 gives a schematic of the first ten years of the lead-in period.

(3) The plant suffers no diminution of capacity over its lifetime. It maintains the ability to operate at 100 percent capacity for the entirety of its thirty-year life. Accounting depreciation is taken for revenue requirements and financial statements even though capacity depreciation is assumed to be zero. This is not an unrealistic assumption for most utilities.

(4) Costs are assumed to be constant and no economies of scale exist. This assumption is justified for the lead-in-period due to the fact that over most of the history of the electric utility industry plant cost per kilowatt of capacity remained stable. Economics of scale were normally sufficient to offset the effects of inflation prior to the late 1960's (12).

This system can be expressed as follows: Let t_n represent the time at which the $n^{\underline{th}}$ investment in plant of capacity size z_n is to go "on-line." Each projected plant capacity increase is represented as:

$$z_n = \{D_{t_n} - D_{t_{n-1}}\} + .10\,\{D_{t_n} - D_{t_{n-1}}\} \qquad (1)$$

D_{t_n} = the projected demand five years after the plant z_n goes "on-line."

$D_{t_{n-1}}$ = the portion of demand projected five years after z_n goes "on-line" which can be met with existing plant-in-service exclusive of z_n.

The total projected capacity five years in the future can be expressed as Z_n at time t_n.

$$
\begin{aligned}
Z_n &= \sum_{k=1}^{n} z_k \quad n < 6 \\
Z_n &= \sum_{k=0}^{5} z_{n-k} \quad n \geq 6
\end{aligned}
\qquad (2)
$$

Since costs are assumed to be constant and there are no economies of scale, the cost of each investment in capacity of size z_n can be expressed as:

$$C\{t_n\} = kz_n^{\,a}$$

k = the dollar cost per unit of capacity. During the lead-in-period this is equal to \$.002267.

a = 1 reflecting the lack of economies of scale.

The investment, $C\{t_n\}$, is spread equally over the five year construction period. Therefore, yearly CWIP additions, exclusive of the cost of funds, can be expressed as $1/5\ C\{t_n\}$.

Example:

The calculations for the construction of the second plant (n=2) beginning in year 1 can be seen below.

Capacity size z_2 is calculated as:

$$z_2 = \{D_{t_2} - D_{t_1}\} + .10\ \{D_{t_2} - D_{t_1}\}$$

D_{t_2} refers to demand at the beginning of year 11, which is projected to be 127.51 kw/yr. (D_{t_2} = 127.51). The plant will go "on-line" at the beginning of year 6(t_2=6). The demand which can be met with capacity z_1 is 100 kw ($D_{t_1} + .10D_{t_1}$).

Therefore, $z_2 = \{127.51 - 90.91\} + .10 \{127.51 = 90.91\}$

$z_2 = 40.26$

and the total capacity when plant z_2 goes 'on-line" is:

$Z_2 = z_1 - z_2$

$Z_2 = 100 + 40.26$

$Z_2 = 140.26$

The annual investment in CWIP for plant number 2 is calculated as follows:

$1/5\ C\{t_n\} = 1/5(kz_n{}^a)$

$1/5\ C\{t_n\} = 1/5(.002267)(40.26)$

CWIP = .01825

Table 37 shows the time diagram for capacity and demand for the first ten years of the simulation lead-in period and Table 38 shows the capacity investment schedule for this period.

TABLE 37

TIME DIAGRAM FOR CAPACITY AND DEMAND FOR THE FIRST TEN YEARS OF THE SIMULATION LEAD-IN-PERIOD

Year	1	6	11
Plants-in-service:	1	1,2	1,2,3
Total capacity (Z_n):	100	140.261	193.723
Capacity increments (z_n):		40.261	56.462
Demand:	64.1688	90.91	127.51
CWIP commensed (Plant #):	2	3	4

GROWTH: 7%

TABLE 38

CAPACITY INVESTMENT SCHEDULE FOR SIMULATION LEAD-IN-PERIOD

Year	1	6	11	16	21
Investment increment (n)	1	2	3	4	5
Plants-in-service	1	1-2	1-3	1-4	1-5
Plant retired currently	0	0	0	0	0
Construction commenced on plant	2	3	4	5	6
Year	26	31	36	41	46
Investment increment (n)	6	7	8	9	10
Plants-in-service	1-6	2-7	3-8	4-9	5-10
Plants retired currently	0	1	2	3	4
Construction commenced on plant	7	8	9	10	11
Year	51	56	61	66	71
Investment increment (n)	11	12	13	14	15
Plants-in-service	6-11	7-12	8-13	9-14	10-15
Plant retired currently	5	6	7	8	9
Construction commenced on plant	12	13	14	15	16
Year	76	81	86	91	96
Investment increment (n)	16	17	18	19	20
Plants-in-service	11-16	12-17	13-18	14-19	15-20
Plant retired currently	10	11	12	13	14
Construction commenced on plant	17	18	19	20	21

TABLE 39

BALANCE SHEET GENERATED BY IFPS

Reports Generated by IFPS. The financial statements generated by IFPS can be seen in Tables 39 and 40.

CAP Firm - year 6

Assets	
PSC BKVAL OF ASSET (101)*	$82.79
PSC BKVAL OF ASSET (76)	2.10
PSC BKVAL OF ASSET (81)	6.63
PSC BKVAL OF ASSET (86)	14.46
PSC BKVAL OF ASSET (91)	27.71
PSC BKVAL OF ASSET (96)	48.85
ACCUM CWIP	18.23
ACCUM AFUDC CAP	1.93
	$202.68
Liabilities and Stockholders' Equity	
Long Term Debt	$107.07
Deferred Income Taxes	24.23
Total Liabilities	131.30
Common Equity	71.38
Total	$202.68

*Year in parenthesis is year that plant was placed in service. Since there was a 95 year lead-in period, the first asset listed went on line at the beginning of year 6.

TABLE 40

INCOME STATEMENTS
GENERATED BY IFPS
CAP Firm - Year 6

	To Stockholders		To IRS	
Operating Revenues		99.61		99.61
Expenses				
Fuel Costs	38.85		38.85	
Other Oper.	18.93		18.93	
Depreciation	8.64		9.36	
Misc. Taxes	7.97		7.97	
Fed. Inc. Taxes	8.45			
Total		82.83		75.10
Operating Income		16.78		24.51
AFUDC Income		1.93		
Interest Charges		- 9.64		- 9.64
Net Income (STK)		$ 9.07		
Taxable Income				14.87
FEDERAL INCOME TAXES				- 7.14
Net Income (IRS)				$ 7.73
PSC Rate Base	158.29			

APPENDIX CHAPTER VI

A comparison of responding and nonresponding electric utilities to the questionnaire survey is given in Table 41, a list of responding firms is given in Table 42, and a copy of the questionnaire in Table 43. A comparison of responding and nonresponding Public Service Commissions is given in Table 44, a list of the responding commissions is given in Table 45, and the commission questionnaire in Table 46. Factors which electric utilities consider in determining the amount of CWIP to include in the rate base is given in Table 47.

TABLE 41

COMPARISON OF RESPONDING AND NONRESPONDING ELECTRIC UTILITIES

Classified by Revenues	Responding Firms		Nonresponding Firms	
	Number	%	Number	%
Revenues in excess of $100,000,000	45	68.18	21	65.63
Revenues between $50,000,000 and $100,000,000	3	4.55	4	12.50
Revenues between $10,000,000 and $25,000,000			1	3.13
Operating subsidiaries of rine holding companies	15	22.72	6	18.75
Others: omitted from sample	3	4.55		
	66	100%	32	100%
Classified by Location				
North Atlantic	22	34.38	7	20
South Atlantic	7	10.94	3	8.57
North Central	15	23.44	11	31.43
South Central	10	15.63	8	22.86
Plateau	5	7.81	4	11.43
Pacific	5	7.81	2	5.71
Alaska & Hawaii				
	64	100%	35	100%

TABLE 42

RESPONDING FIRMS

Alabama Power Company
Allegheny Power System, Inc.
American Electric Power Service
Arizona Public Service Company
Arkansas-Missouri Power Company
Atlantic City Electric Company
Baltimore Gas & Electric Company
Boston Edison Company
Carolina Power & Light Company
Central Illinois Public Service Company
Central Power and Light Company
Cheynne Light, Fuel and Power Company
The Cleveland Electric Illuminating Company
Commonwealth Edison Company
Consolidated Edison Company
Dallas Power & Light Company
The Dayton Power and Light Company
Delmarva Power & Light Company
The Detroit Edison Company
Duquesne Light Company
Eastern Utilities Associates
El Paso Electric Company
Florida Power & Light Company
Florida Power Corporation
Georgia Power Company
Houston Lighting & Power Company
Idaho Power Company
Indianapolis Power & Light Company
Iowa-Illinois Gas and Electric Company
Iowa Power & Light Company
Kansas City Power & Light Company
Kansas Power & Light Company
Louisianna Power & Light Company
Middle South Utilities, Inc.
Mississippi Power & Light Company
Missouri Public Service Company
New England Gas & Electric Association
New Orleans Public Service, Inc.
New York State Electric & Gas Corporation
Niagara Mohawk Power Corporation
Northeast Utilities Service Company
Northern States Power Company
Orange & Rockland Utilities, Inc.
Otter Tail Power Company

TABLE 42

(CONTINUED)

Pacific Gas & Electric Company
Pennsylvania Power & Light Company
Philadelphia Electric Company
Portland General Electric Company
Potomac Electric Power Company
Public Service Company of Colorado
Public Service Company of New Hampshire
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Puget Sound Power & Light Company
Rochester Gas & Electric Corporation
San Diego Gas & Electric Company
Southern California Edison Company
The Southern Company
Southern Services, Inc.
Tampa Electric Company
The Toledo Edison Company
The United Illuminating Company
Utah Power & Light Company
Wisconsin Electric Power Company
Wisconsin Power & Light Company
Wisconsin Public Service Corporation

TABLE 43

QUESTIONNAIRE ON ACCOUNTING FOR CONSTRUCTION WORK IN PROGRESS

The Florida PSC recently began permitting utilities under its jurisdiction to include some amount of CWIP in their rate bases without offsetting AFUDC credits. Other utility commissions and companies are considering this procedure or similar ones designed to convert some amount of AFUDC credits to cash income in order to increase cash flows, improve the quality of reported earnings, and lower the cost of debt and equity capital.

Such procedures reduce future rate bases, hence lower future revenue requirements and service rates, but they also increase current revenue requirements and service rates, making implementation politically difficult.

With the support of the major Florida utilities, the Legislature, and the PSC, we now have underway a research project designed to determine just how large the cash earnings from CWIP should be and the best way of structuring the accounts to produce the desired results. To assist us with this study, we ask that you complete the attached questionnaire. Many of the issues involve subtle points, so please feel free to elaborate on your answers if this would help avoid a misinterpretation. The information on each company will, of course, be kept strictly confidential. Also, please note that if you would like a copy of our report, which should be completed in the Spring of 1978, you should complete the last page of the questionnaire.

TABLE 43

(CONTINUED)

CWIP Questionnaire

Due to the somewhat diverse information called for in the questionnaire, it may be impossible for one person to fill out the entire questionnaire. Accordingly, we have broken it down into three sections (1) Account Treatment of CWIP, (2) Size and Nature of the Construction Program, and (3) Theoretical Issues involved in CWIP Accounting.

SECTION I. Accounting Treatment of CWIP

1. Which of the following methods (a, b, or c) best describes the way your firm accounts for CWIP?

   a. CWIP is included in the rate base. AFUDC is not calculated hence it is not treated as a credit when determining revenue requirements. Thus, CWIP provides cash earnings.

      (1) All of our CWIP is treated as described above. ______

      (2) Approximately _____% (annual average) of our CWIP is currently handled as described above. ______

   b. CWIP is included in our rate base, but AFUDC is calculated and used as an offsetting credit to reduce revenue requirements.

      (1) The rate used to calculate AFUDC (____%) is the same as the rate of return applied to the rate base. Thus, our CWIP produces no cash earnings. ______

      (2) Our AFUDC rate (____%) is lower than our allowed rate of return on the rate base (____%). Thus, our CWIP does indirectly provide us with some cash revenues. ______

TABLE 43

(CONTINUED)

(3) Our AFUDC rate (____%) is higher than our allowed rate of return on the rate base (____%). Thus, our CWIP actually reduces cash flows from operating assets. ________

c. CWIP is not included in our rate base. AFUDC is calculated to provide a return on CWIP. AFUDC is then capitalized, and a cash return is eventually earned through depreciation charges and a higher rate base once the project has been completed and placed in service. ________

2. If AFUDC is calculated and added to CWIP (i.e., "capitalized"), then CWIP will include both actual expenditures and capitalized AFUDC. As long as a project remains under construction, it will (generally) continue to accure AFUDC. However, AFUDC in subsequent years may or may not be allowed on the AFUDC component of CWIP. Thus, there may be no "compound interest" associated with the return on funds invested in CWIP. (See Appendix for example.)

a. We do accrue AFUDC on the AFUDC component of CWIP, so we do earn a "compound interest" return on our investment in CWIP. ________

b. We do not accrue AFUDC on the AFUDC component of CWIP. ________

3. A recent FPC regulation requires a separate formulary calculation for borrowed funds and "other" equity funds. The "allowance for borrowed funds used during construction" is deducted from "Other Interest Expense" and the "allowance for other funds used during construction" is credited to "Other Income."

Which of the following best describes your firm?

a. We use the FPC procedure for FPC jurisdictional facilities only. ________

b. We use the FPC procedure for both FPC and non-FPC jurisdictional facilities. ________

c. We do not use the FPC formula at all. ________

TABLE 43

(CONTINUED)

4. The FPC formula for calculating the AFUDC rate for borrowed funds gives more weight to current short-term debt than it does to other sources of funds. All short-term debt is assumed to apply to CWIP.

   a. What was your year-end 1976 percentage of short-term debt to CWIP? ________

   b. What is your projected year-end 1977 percentage of short-term debt to CWIP? ________%

   c. What is your projected year-end 1978 percentage of short-term debt to CWIP? ________%

5. As a result of using debt to support the construction program, income taxes during the construction period are less than they would be in the absence of the construction. The tax benefits resulting from the payment of interest should benefit the customers who actually pay the interest charges. If interest is capitalized as part of AFUDC, future customers will be the ones who pay the interest charges and who should therefore receive the tax benefits. Theoretically, the tax timing differences should thus be deferred until the asset goes on line and then be normalized over the operating life of the asset. Does your company handle the tax timing difference as described above, or do you flow these benefits through to current customers?

   a. We normalize this tax timing difference, thus allocating the interest tax shelter to the future customers who will actually pay the interest charges. ________

   b. We flow the tax timing difference through to current customers. ________

   c. Other (please explain) ______________________________

   ____

6. Most utilities' bond indentures require a minimum pro forma times interest earned ratio before bonds may be issued, and many also limit the amount of AFUDC and other nonoperating income that can be included in the coverage calculation. Does your indenture include such limitation, and if so, has it affected your financing?

TABLE 43

(CONTINUED)

a. There are no restrictions in our bond indenture that would cause a high ratio of AFUDC to operating income to limit our use of mortgage debt. ________

b. Only a portion of AFUDC and other non-operating income is allowed in the coverage calculation. ________

  (1) However, this indenture provision has never actually prevented us from issuing bonds. ________

  (2) The provision has actually prevented us from issuing bonds in the past. ________

c. Other (please explain) ____________________________

____

____

____

TABLE 43

(CONTINUED)

SECTION II. Size and Nature of Construction Program

7. The effect of CWIP depends to a large extent upon the nature of a company's construction program. How important has CWIP been for your company, and how important is it projected to be assuming that your present construction plans are carried out and that your current accounting practices are continued?

	Approximate Average Percentages for Indicated Periods			
	1972-1976	1977	1978-1982	1983-1987
a. Rate Base Assets, excluding CWIP	%	%	%	%
CWIP (including accumulated AFUDC)				
Total	100%	100%	100%	100%
b. Percent of CWIP represented by AFUDC	%	%	%	%
c. Average yearly balance of CWIP (including accumulated AFUDC)	$	$	$	$

8. On the average, what percentage of your generation construction expenditures will be accounted for by each of the following types:

	1972-1976	1977	1978-1982	1983-1987
Nuclear	%	%	%	%
Coal				
Oil				
Gas				

TABLE 43

(CONTINUED)

	1972-1976	1977	1978-1982	1983-1987
Hydro				
Other				
Total	100%	100%	100%	100%

TABLE 43

(CONTINUED)

SECTION III. Theoretical Issues Involved in CWIP Accounting

9. The Florida Public Service Commission presently allows a portion of CWIP in the rate base. The determination of the amount included has been on a somewhat ad hoc basis in the past. We would like, if possible, to develop a methodology for use in determining an optimal amount of CWIP to include in the rate base. This procedure should balance the interests of present customers, future customers and investors. Our preliminary research suggests that the procedure should take account of the following factors: (1) effects of AFUDC on the quality of earnings, hence on the availability and cost of capital, (2) the percentage of CWIP invested for current versus future customers, and (3) customers discount rates (the time value of money to customers). If you can suggest a methodology, or a formula, for determining the amount of CWIP for inclusion in the rate base, we would very much appreciate your sharing it with us.

   a. We have no formula and know of no way to develop one. ____

   b. We do have a formula, or systematic procedure, which could be used. (Please respond on a separate sheet.) ____

   c. We do not have a formula or a specific procedure, but we do suggest that such a procedure could be developed along the following lines. (Please respond on a separate sheet.) ____

10. If some amount of AFUDC is to be capitalized, then how should each of the following be handled?

   a. Allow a return on the AFUDC component of CWIP (i.e., "compound" AFUDC). YES____ NO ____

   b. Normalize the income tax benefit resulting from the interest on borrowed funds for construction, rather than flowing it through to current customers. YES____ NO ____

   c. Set the AFUDC rates as follows:

      (1) Equal to the rate of return used to set service rates. ____

TABLE 43

(CONTINUED)

(2) Equal to the weighted average cost of all capital. (In theory, (1) and (2) should be the same.) ________

(3) Equal to the cost of new capital (marginal cost). ________

(4) Below the weighted average cost of capital. ________

(5) Above the weighted average cost of capital. ________

(6) In accordance with FPC formula. ________

11. If a company had a stable set of customers, and if their relative usage rates remained constant, then by definition all construction expenditures would be for the benefit of the existing customers for improved or expanded service. In this case, one could make an excellent argument for including all CWIP in the rate base and charging current customers a return on this investment. On the other hand, if the entire construction budget were for new facilities to meet the needs of expected new customers, then it could be argued that none of the CWIP should be included in the current rate base.

In fact, neither of these conditions exist: many projects will provide for (1) expanded usage of existing customers, (2) more reliable and/or lower cost service, and also (3) new service for a net increase in customers. Also, it is difficult to allocate the benefits of many new projects to net new customers versus the existing base of customers. Still, if you can provide approximate estimates of this breakdown, please fill out the table on the following page, as this type of information may well be a key element in any formula used to decide how much CWIP should be included in the rate base.

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University of Florida
Gainesville, Florida. 32611
(904) 392-0141

TABLE 43

(CONTINUED)

If you would like a copy of our report, please complete the following:

Name____

Company____

Position____

Address____

TABLE 43

(CONTINUED)

	1972-76	1977	1978-82	1983-87
a. Construction primarily for the benefit of existing service area customers. (% of total construction program.)				
1. Installation of pollution equipment to existing plant.	%	%	%	%
2. Conversion from coal to cleaner fuel for environmental reasons.				
3. Conversion from oil to coal to conserve oil.				
4. Replacement of obsolete plant and equipment, including voluntary conversions to reduce fuel costs.				
5. Construction of new facilities to meet expanded usage of present service area customers.				
Residential				
Commercial				
Industrial				
Other, including wholesale				

TABLE 43

(CONTINUED)

	1972-76	1977	1978-82	1983-87
6. Other construction for benefit of existing service area customers (please explain).				
Total percentage of construction primarily for the benefit of existing service area customers.	%	%	%	%
b. Construction of new facilities to meet the needs of new service area customers:				
Residential				
Commercial				
Industrial				
Other, including wholesale				
Total for benefit of new customers				
GRAND TOTAL	100%	100%	100%	100%

TABLE 43

(CONTINUED)

Appendix to Question 2

a. No Compound Interest Effect

Expenditures	Cumulated Expend.	AFUDC Based on Cum. Exp.	Cum. Exp. + AFUDC	AFUDC Based on Cum. Exp. + AFUDC
100	100	10	100	11
100	200	20		
100	300	30		
100	400	40		
100	500	50		
		150		

Added to rate base when plant goes in service:
500 + 150 = $650.

b. Compound Interest Effect

Beginning CWIP	Expenditures	AFUDC Based on Beginning CWIP + Exp.	Ending CWIP
0	100	10	110
110	100	21	231
231	100	33.1	364
364	100	46.41	510.51
510.51	100	61.05	671.56
	500	171.56	

Added to rate base: 500 + 171.56 = 671.56.

Percent difference in return: 171.56/150 - 1.0 = 14.4%.

TABLE 44

COMPARISON OF RESPONDING AND NONRESPONDING PUBLIC SERVICE COMMISSIONS

Classified by Location	Responding Commissions		Nonresponding Commissions	
	Number	%	Number	%
North Atlantic	6	17	3	18.75
South Atlantic	5	14.71	3	18.75
North Central	7	20.59	4	25.00
South Central	5	14.71	5	31.25
Plateau	6	17.65	0	0
Pacific	3	8.82	1	6.25
Alaska & Hawaii	2	5.88		
	34	100%	16	100%

TABLE 45

RESPONDING PUBLIC SERVICE COMMISSIONS

Alaska
California
Colorado
Connecticut
Delaware
District of Columbia
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Louisiana
Maine
Massachusetts
Michigan
Minnesota
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Mexico
North Carolina
North Dakota
Oklahoma
Oregon
South Carolina
South Dakota
Tennessee
Texas
Virginia
Washington
West Virginia
Wyoming

TABLE 46

PSC QUESTIONNAIRE

State: ________________________

Section I. Accounting Treatment of CWIP

1. Does your state have a law prohibiting the inclusion of CWIP in the rate base? ________

2. Which of the following methods (a, b, or c) best describes the way your Commission allows firms to account for CWIP? ________

    a. CWIP may be included in the rate base. AFUDC is not calculated, hence it is not treated as a credit when determining revenue requirements. Thus, CWIP provides cash earnings.

        (1) All CWIP is treated as described above. ________

        (2) Approximately ____% (annual average) of CWIP is currently handled as described above. ________

    b. CWIP is included in the rate base, but AFUDC is calculated and used as an offsetting credit to reduce revenue requirements.

        (1) The rate used to calculate AFUDC (____%) is the same as the rate of return applied to the rate base. Thus, CWIP produces no cash earnings. ________

        (2) The AFUDC rate (____%) is lower than the allowed rate of return on the rate base (____%). Thus, CWIP actually reduces cash flows from operating assets. ________

        (3) The AFUDC rate (____%) is higher than the allowed rate of return on the rate base (____%). Thus, CWIP actually reduces cash flows from operating assets. ________

TABLE 46

(CONTINUED)

c. CWIP is not included in the rate base. AFUDC is calculated to provide a return on CWIP. AFUDC is then capitalized, and a cash return is eventually earned through depreciation charges and a higher rate base once the project has been completed and placed in service. ________

3. Does your Commission allow compounding on the AFUDC component of CWIP? ________

4. As a result of using debt to support the construction program, income taxes during the construction period are less than they would be in the absence of the construction. Which of the following methods does your Commission use to handle these tax benefits?

   a. We allow companies to normalize this tax timing difference, thus allocating the interest tax shelter to the future customers who will actually pay the interest. ________

   b. We flow through the tax timing differences to current customers. ________

   c. Other (please explain) ________________________________

   ____

   ____

Section II. Theoretical Issues Involved in CWIP Accounting

5. The Florida Public Service Commission presently allows a portion of CWIP in the rate base. The determination of the amount included has been on a somewhat ad hoc basis in the past. We would like, if possible, to develop a methodology for use in determining an optimal amount of CWIP to include in the rate base. This procedure should balance the interests of present customers, future customers, and investors. Our preliminary research suggests that the procedure should take account of the following factors: (1) effects of AFUDC on the quality of earnings, hence on the availability and cost

TABLE 46

(CONTINUED)

of capital, (2) the percentage of CWIP invested for current versus future customers, and (3) customers' discount rates (the time value of money to customers). If you can suggest a methodology, or a formula, for determining the amount of CWIP for inclusion in the rate base, we would very much appreciate your sharing it with us.

a. We have no formula and know of no way to develop one. ________

b. We do have a formula, or systematic procedure, which could be used. (Please respond on a separate sheet.) ________

c. We do not have a formula or a specific procedure, but we do suggest that such a procedure could be developed along the following lines. (Please respond on a separate sheet.) ________

6. If some amount of AFUDC is to be capitalized, then how should each of the following be handled?

a. Allow a return on the AFUDC component of CWIP (i.e., "compound" AFUDC). YES____ NO ____

b. Normalize the income tax benefit resulting from the interest on borrowed funds for construction, rather than flowing it through to current customers. YES____ NO ____

c. Set the AFUDC rates as follows:

(1) Equal to the rate of return used to set service rates. ________

(2) Equal to the weighted average cost of all capital. (In theory, (1) and (2) should be the same.) ________

(3) Equal to the cost of new capital (Marginal cost). ________

(4) Below the weighted average cost of capital. ________

TABLE 46

(CONTINUED)

(5) Above the weighted average cost of capital. ________

(6) In accordance with the FPC formula. ________

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Gainesville, Florida. 32611
(904) 372-0142

If you would like a copy of our report, please complete the following:

Name____

Company____

Position____

Address____

TABLE 47

FACTORS TO CONSIDER IN DETERMINING THE AMOUNT OF CWIP TO INCLUDE IN THE RATE BASE

- Size of the construction program - total dollars and as a percent of existing investment.
- Growth rate in plant investment, sales, customers, peak load.
- Cost of new facilities compared to embedded cost of existing facilities.
- Cash flow needs of the Company.
- External financing needs of the Company.
- Financial ratios, such as capitalization ratios, coverage ratios.
- State of the financial markets.
- Cost of new issue securities.
- Portion of construction due to environmental requirements.
- Amount for conversion from oil to coal.
- Amount related to actions to lower dependence on scarce fuels, such as building coal and nuclear to meet nation's energy goals.
- Replacement of obsolete, deteriorated and inefficient plant and equipment.
- The economics of the system where base load plants become mid-range or peaking units when new base load plants are completed.
- Up-grading of the system to improve system reliability.
- Attrition being experienced by the Company.
- Effect on current and future revenue requirements.

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BIOGRAPHICAL SKETCH

Geraldine Westmoreland was born in Clearwater, Florida, on March 9, 1937. She was graduated from Ocala High School in 1955. In 1960, Ms. Westmoreland received a Bachelor of Science in Chemistry degree from the University of Florida. She was employed as a research and development chemist prior to returning to the University of Florida in September, 1972, to study accounting. She is a Certified Public Accountant. Ms. Westmoreland was a research assistant at the Public Utility Research Center in Gainesville, Florida. In 1977, she was elected to Alpha Iota Delta, honorary decision science society.

I certify that I have read this study and that in my opinion it confirms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

E Daniel Smith

E. Daniel Smith
Associate Professor of Accounting

I certify that I have read this study and that in my opinion it confirms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

E F Brigham

Eugene F. Brigham
Graduate Research Professor of Finance

I certify that I have read this study and that in my opinion it confirms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Sanford V. Berg

Sanford V. Berg
Associate Professor of Economics

This dissertation was submitted to the Graduate Faculty of the Department of Accounting in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December, 1979

Dean, Graduate School

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